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# ENVIRONMENTAL ASSESSMENT BOARD



## ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARINGS

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VOLUME: 135

DATE: Thursday, April 16, 1992

BEFORE:


HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

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ENVIRONMENTAL ASSESSMENT BOARD  
ONTARIO HYDRO DEMAND/SUPPLY PLAN HEARING

IN THE MATTER OF the Environmental Assessment Act,  
R.S.O. 1980, c. 140, as amended, and Regulations  
thereunder;

AND IN THE MATTER OF an undertaking by Ontario Hydro  
consisting of a program in respect of activities  
associated with meeting future electricity  
requirements in Ontario.

Held on the 5th Floor, 2200  
Yonge Street, Toronto, Ontario,  
Thursday, the 16th day of April,  
1992, commencing at 10:00 a.m.

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VOLUME 135  
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B E F O R E :

THE HON. MR. JUSTICE E. SAUNDERS	Chairman
DR. G. CONNELL	Member
MS. G. PATTERSON	Member

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1 ---On resuming at 10:03 a.m.

2 THE REGISTRAR: This hearing is now in  
3 session. Be seated, please.

4 THE CHAIRMAN: Mr. Campbell?

5 MR. B. CAMPBELL: Thank you, Mr.  
6 Chairman.

7 I have been asked to just note on the  
8 record that there has been an exhibit filed by Ontario  
9 Hydro, I believe the designation is 452F, it updates  
10 figures and data from chapter 16 of the DSP report.  
11 You will have noted as we follow through that the  
12 figures have been consistently updated through the  
13 report for the Update. So that has now been filed, as  
14 I understand it.

15 ---EXHIBIT NO. 452F: Update of figures and data from  
16 chapter 16 of the DSP report.

17 MR. B. CAMPBELL: I have also been  
18 advised by Dr. Whillans and have spoken to my friend  
19 Mr. Mattson about this, that Dr. Whillans has, as I  
20 understand it, given some further thought to Dr.  
21 Connell's question of yesterday in relation to  
22 carbon-14 at the end of the hearing there and wishes to  
23 expand somewhat on the matters raised by Dr. Connell,  
24 and if he could be given permission to do that. I  
25 think it is sensible that it be done before the

1 cross-examination continues.

2 THE CHAIRMAN: Dr. Whillans?

3 DAVID WHILLANS,  
4 KURT JOHANSEN,  
5 FRANK CALVIN KING,  
6 WILLIAM JOHN PENN,  
7 IAN NICHOL DALY; Resumed.

8 DR. WHILLANS: Well, I have been  
9 discussing with Ms. McClenaghan yesterday and the day  
10 before the relative significance of long-lived  
11 radionuclide emissions such as carbon-14. Dr. Connell  
12 had asked for some perspective and I thought it might  
13 be useful to prepare a summary slide which presents  
14 just a summary of the information and the references I  
15 was using, which was UNSCEAR and the NCRP report. I  
16 thought perhaps that would be easier to understand  
17 visually than just the way I have been describing it.

18 THE CHAIRMAN: We should mark the slide  
19 as an exhibit?

20 DR. WHILLANS: I think we have copies.

21 THE CHAIRMAN: It's already been put in?

22 MR. B. CAMPBELL: No. It's been left  
23 sitting on my desk and I just now discovered what it  
24 is.

25 THE CHAIRMAN: What is the next exhibit  
number?

THE REGISTRAR: 620, Mr. Chairman.

1       ---EXHIBIT NO. 620: Sources of Carbon-14 Exposures.

2                   DR. WHILLANS: These are simply summaries  
3 taken from the reference cited, and I hope to give some  
4 perspective about the situation.

5                   On the first page you can see a summary  
6 of the world inventory, and this is taken from the NCRP  
7 report, Report 81, I have given a rather simplified  
8 view of it. There are many sources, but basically the  
9 atmosphere contains about 140,000 terabecquerels. The  
10 ocean contains 9.3 million terabecquerels, and there is  
11 exchange but the exchanges with the surface water and  
12 exchanges in the deep ocean is much slower and so the  
13 modelling of this is fairly complicated. But the  
14 number in the atmosphere is 140,000 terabecquerel.

15                   Now, the major sources are listed below,  
16 cosmic is about 1,400 terabecquerel per year, total  
17 nuclear power generation is about 600, and heavy waters  
18 contributes substantially to that. So heavy water --

19                   THE CHAIRMAN: Is the 140 part of the  
20 600?

21                   DR. WHILLANS: Yes, it is.

22                   So you could see that the heavy water  
23 reactors generally, and Ontario Hydro operates a fair  
24 fraction of those, do contribute perhaps 20 per cent to  
25 the annual increment in the global inventory.



1                   Turning to the second page, I have tried  
2   to summarize from 1988 UNSCEAR document the  
3   distribution of carbon-14 doses focusing on heavy water  
4   reactor operation. And the numbers that are derived  
5   from that reference are that the local and regional  
6   dose is about 11 person sieverts per gigawatt year, and  
7   I would note that that number is larger than the number  
8   that we have in our annual summary for a particular  
9   year and that's because there is persistence in the  
10  environment and also because the UNSCEAR data is based  
11  on average conditions and the emissions, for example,  
12  from other reactors could be quite different.

13                   Now, in comparison, the global dose about  
14  which we were talking is broken down into four time  
15  periods in the UNSCEAR document. And you can see that  
16  over the first 10 years local dose accounts for most of  
17  the person sieverts per gigawatt year. And this  
18  increases over 100 years, 1,000 years and 10,000 years,  
19  to a value which is much greater.

20                   As I said, UNSCEAR recommends that we  
21  place relatively less significant on values beyond 100  
22  or 500 years because of the great uncertainty in those  
23  calculations.

24                   On the third page I have tried to bring  
25  together information from UNSCEAR and also from our own

1 environmental summary, which was given Exhibit No.  
2 520.15. This is the annual summary and assessment of  
3 environmental and radiological data for 1990, which I  
4 have taken as a reference year.

5 In that document the maximum critical  
6 group dose which occurs to infants residing near  
7 Pickering is about .008 millisieverts for carbon-14.

8 If we talk about the mean local dose, and  
9 the UNSCEAR document defines local as meaning within  
10 100 kilometres, take the population of roughly 2  
11 million, the mean local dose from carbon-14 emissions  
12 from Pickering is .00015 millisieverts.

13 If we convert some of those committed  
14 doses over various periods of time to the mean global  
15 dose to a population, for the 10-year period UNSCEAR  
16 uses 4 billion and 10 billion for the others, you can  
17 see the numbers are very, very small on average.

18 And finally, I just note that for  
19 comparison the mean total dose from all natural  
20 background sources is about 3 millisieverts per year.

21 The final page is one which I referred to  
22 a couple of days ago from the NCRP report, which  
23 compares doses on the vertical scale, this is tissue  
24 dose rate in millirads per year. We have talked about  
25 sieverts and millisieverts, but the conversion is, a

1 millirad is 1/100th of a millisievert. And it is also  
2 shown for the period from about 1950 to 2000.

3 At the present time, as you can see, the  
4 average dose rate to the population is about 1 per cent  
5 from nuclear power and the rest is from the inventory  
6 that I described on the earlier pages.

7 I hope that provides some perspective.

8 Now, we also talked actually about  
9 tritium and radon. And I would note also that in the  
10 UNSCEAR document in Appendix B of the 1988 report on  
11 paragraph 184 --

12 THE CHAIRMAN: Hold it. Where was that  
13 again? What was of the reference? You were starting  
14 to read of the reference.

15 DR. WHILLANS: Sorry. It's the UNSCEAR  
16 1988 document, the same one that I have been taking  
17 information on carbon-14 from.

18 THE CHAIRMAN: That is not an exhibit; is  
19 that correct?

20 DR. WHILLANS: I think it is not. It's  
21 in appendix B.

22 THE CHAIRMAN: Perhaps it should be an  
23 exhibit, Mr. Campbell.

24 MR. B. CAMPBELL: Yes, if we could get a  
25 number, it's been referred to enough times now, I will

1 make sure copies are provided.

2 THE CHAIRMAN: Thank you.

3 THE REGISTRAR: Exhibit number?

4 THE CHAIRMAN: Best give it an exhibit  
5 number now and file it later.

6 THE REGISTRAR: 621.

7 THE CHAIRMAN: Thank you.

8 ---EXHIBIT NO. 621: UNSCEAR 1988 document.

9 DR. WHILLANS: I was turning to the other  
10 question we discussed which was tritium. Tritium of  
11 course has a radiological half life of only about 12.3  
12 years compared with the 5,700 --

13 THE CHAIRMAN: You said only but some  
14 people said that's a long half life.

15 DR. WHILLANS: That's true, but compared  
16 with what we have just talked about, it's very short.

17 I think the point I am trying to make is  
18 that although it is 12 years compared with some of the  
19 other nuclides, the times of mixing and redistribution  
20 in the environment are very long on that scale. So the  
21 quote I was going to refer you to was in paragraph 184,  
22 of appendix B, where it points out that the local dose  
23 contribution from tritium - they are referring  
24 primarily to tritiated water - emissions is more than  
25 100 times than that of the global contribution, and

1       this reflects the fact that even with a 12-year half  
2       life dispersion and exposure of the global population  
3       is relatively small.

4                     I think that's probably more than you  
5       wanted to know.

6                     DR. CONNELL: Dr. Whillans, your graph,  
7       your fourth page, it doesn't stipulate whether this is  
8       data just for carbon or for all radionuclides.

9                     DR. WHILLANS: I'm sorry, this is from  
10      the Report 81 which is called carbon-14 in the  
11      environment, and this is just carbon-14.

12                    DR. CONNELL: Thank you.

13                    DR. WHILLANS: Yes.

14      [10:12 a.m.]

15                    THE CHAIRMAN: Is that it?

16                    DR. WHILLANS: I think so.

17                    THE CHAIRMAN: Mr. Mattson?

18                    MR. MATTSON: Thank you. As I am sure  
19      you are aware, Ms. McClenaghan is not here with us this  
20      morning, and she apologizes, but because she is getting  
21      married this afternoon she decided that I should  
22      complete her cross-examination and give her the morning  
23      off.

24                    THE CHAIRMAN: Well, that is the most  
25      remarkable prenuptial performance I have ever seen.



1 [Laughter]

2 MR. MATTSON: So bear with me as I  
3 continue on.

4 CROSS-EXAMINATION BY MR. MATTSON:

5 Q. We will be first of all finishing  
6 with the questions yesterday with respect to toxicity  
7 that ended the day yesterday, and I believe, Dr.  
8 Whillans, at the end of the day we heard you say that  
9 the TRF was partly justified and partly justified by  
10 reduction of doses to workers; is that correct?

11 DR. WHILLANS: A. I believe that's  
12 correct.

13 Q. And I will direct this question to  
14 you, Mr. Daly.

15 Wasn't it largely justified, not partly  
16 justified, but wasn't it largely justified at least to  
17 Ontario Hydro's board of directors by the economic  
18 promise of increased production, i.e. the removal of a  
19 need to shut down when the reactor started leaking  
20 moderator or heat transport water?

21 MR. DALY: A. You are referring to a  
22 particular document or...?

23 Q. No.

24 A. Well, reducing tritium uptake of the  
25 workers certainly allows for easier maintenance. It



1 won't obviously eliminate all outages. It will make  
2 certain outages easier to carry out, and certainly we  
3 would expect to get some efficiencies as a spinoff, but  
4 I think the main reason was to cut down the dose, and,  
5 you know, along with the policy of ALARA you want to  
6 keep the doses as low as possible, and the TRF can help  
7 to do this, and as a spinoff from that you can do  
8 certain outages with a smaller number of people, and it  
9 generally helps.

10 Q. Mr. Penn, do you have anything to add  
11 to that? Is that essentially correct with respect to  
12 how it was justified to the board of directors, TRF?

13 MR. PENN: A. As far as I recall, that  
14 was the reason, yes - the main reason.

15 Q. Thank you. Now, I believe we have  
16 been dealing with Exhibit 597, and if you would refer  
17 to that exhibit again and turn to page 297 of the  
18 exhibit? At page 297 it is an interrogatory from  
19 Energy Probe ID number 9.2.93, Nuclear Option. And I  
20 believe it should be given a number?

21 THE REGISTRAR: That will be .109.

22 ---EXHIBIT NO. 520.109: Interrogatory No. 9.2.93.

23 MR. MATTSON: Thank you.

24 Q. And the question was: How much  
25 tritium will Darlington have at its maximum at any time

1 in its life? And the answer:

2 The expected variation of tritium in  
3 storage with time is shown in the  
4 attached table 1.

5 And I am turning over to page 298 and 299 of the  
6 exhibit where you will find table 1.

7 Dr. Whillans, could you confirm that this  
8 is the inventory in the TRF; correct?

9 DR. WHILLANS: A. In the future, for  
10 projected.

11 Q. All right. And is it fair to say  
12 that --

13 THE CHAIRMAN: I perhaps should know  
14 this. Is the TRF in place, in operation now?

15 DR. WHILLANS: It has been in operation  
16 since, I believe, 1988 on the Darlington site.

17 THE CHAIRMAN: So year one would be 1988,  
18 would that be...?

19 DR. WHILLANS: Well, I think this is a  
20 theoretical estimation of the activity when it is  
21 running full time. It has had a number of problems in  
22 the initial stages. It is a very sort of high-tech  
23 operation and it hasn't run full time. But essentially  
24 1988 or 1990.

25 THE CHAIRMAN: Thank you.

1 MR. MATTSON: Q. Is it fair to say, Dr.  
2 Whillans, from this table that the amount of tritium  
3 forecast is never expected to exceed 120 megacuries?

4 DR. WHILLANS: A. Yes, that is what it  
5 says.

6 Q. And that would equate to 1.2 times 10  
7 to the 8th curies; correct?

8 A. That's correct.

9 Q. Thank you. Now, if you could turn to  
10 page 127 of the exhibit this was provided in  
11 Interrogatory 2.2.8 from Energy Probe, which has  
12 already been given a number, .93?

13 A. Yes.

14 Q. And again, it is the tritium  
15 emissions to air, and you will see Darlington  
16 Elemental, and under Annual Emissions Allowed by  
17 Regulatory Limit you see 3.6 times 10 to the 9th,  
18 correct, curies?

19 A. I believe that is what it says.  
20 Because your pages were provided to us--

21 Q. Is that number correct?

22 A. --with the holes on the other side we  
23 are missing a little bit of the data.

24 Q. Oh.

25 THE CHAIRMAN: I'm sorry, did you say 3.6

1 times 10 to the 9th?

2 MR. MATTSON: Yes, Mr. Chairman.

3 THE CHAIRMAN: Do I see that somewhere?

4 Yes, I see it. I have got it now.

5 MR. MATTSON: Q. And you can confirm  
6 that that is the correct number, Dr. Whillans?

7 DR. WHILLANS: A. I have no reason to  
8 believe it isn't.

9 Q. Now, if you turn to page 130 of the  
10 exhibit, and, Dr. Whillans, at page 129 you will note  
11 it is a letter to Mr. Rubin.

12 A. That's correct.

13 Q. And at point No. 2 of the letter from  
14 Michael Gillespie at Ontario Hydro he updates the  
15 Interrogatory 2.2.8?

16 A. Yes.

17 Q. And notes that:

18 In addition, the limit for gross beta  
19 gamma emissions to water for Pickering  
20 was incorrectly transcribed as 1.4 times  
21 10 to the 2 curies per year.

22 Correct?

23 A. That is what it says, yes.

24 Q. And you provided tables 1 and 2 there  
25 at page 130 and 131?

1 A. I believe so, yes.

2 Q. Now, I am just looking again with  
3 respect to Darlington.

4 A. On the right-hand side of the  
5 columns?

6 Q. Yes. At table 1?

7 A. Yes?

8 Q. It sets 10 times -- 7 times 10 to the  
9 7th curies per week; correct?

10 A. That is what it says.

11 Q. To air, which is about the same rate;  
12 correct?

13 A. Sorry, the same rate as what?

14 Q. As the one we just saw before, in  
15 curies per year?

16 A. Correct.

17 THE CHAIRMAN: I'm sorry, I can't read  
18 this table very well. Tell me the figure that you are  
19 reading?

20 MR. MATTSON: Yes, Mr. Chairman. On  
21 table 1 on page 130 of the exhibit.

22 THE CHAIRMAN: Yes?

23 MR. MATTSON: Three down, it has Emission  
24 Category: Air?

25 THE CHAIRMAN: Yes?

1 MR. MATTSON: HT.

2 THE CHAIRMAN: Yes?

3 MR. MATTSON: Curies per week? And under  
4 Darlington, which is the very last column--

5 THE CHAIRMAN: Yes?

6 MR. MATTSON: --it has 7 times 10 to the  
7 7th or 7.OE plus .07.

8 THE CHAIRMAN: And that 7.OE is the same  
9 as saying 7 times 10 to the 7th; is that right?

10 MR. MATTSON: Q. Is that correct, Dr.  
11 Whillans?

12 DR. WHILLANS: A. Yes.

13 THE CHAIRMAN: And what is the  
14 significance of the plus 07 after that?

15 DR. WHILLANS: Sorry. Seven .OE plus 07  
16 is a notation for 7.0 times 10 to the plus 7.

17 THE CHAIRMAN: Oh, all right.

18 DR. WHILLANS: So it is comparable, and  
19 Mr. Mattson was asking whether that was the same rate  
20 as on the previous table where it was 3.6 times 10 to  
21 the 9th for 52 weeks. And I had just agreed it was.  
22 [10:25 a.m.]

23 I think this confusion arises because the  
24 derived emission limits are set on an annual basis but  
25 because we control by sampling on a weekly or monthly,



1 depending on whether it's air or water, we have numbers  
2 which are referenced to those periods.

3 So in various tables you see them by the  
4 week or the month or by the year.

5 THE CHAIRMAN: So the first figure, the  
6 one on page 127, was an annual figure and the one on  
7 page 130 is a weekly figure, and the weekly figure  
8 translates into an annual figure; is that right?

9 DR. WHILLANS: I believe it does, yes.

10 THE CHAIRMAN: If that weekly amount  
11 remains constant by the year.

12 DR. WHILLANS: Just multiplying that by  
13 52 should give the same number.

14 THE CHAIRMAN: All right.

15 DR. WHILLANS: Yes.

16 MR. MATTSON: Q. Now, Dr. Whillans, the  
17 reason I have taken you through those documents is to  
18 point out that the annual allowable emission rate at  
19 Darlington is 30 times as large as the total contents  
20 the facility is ever projected to become; is that  
21 correct?

22 DR. WHILLANS: A. That seems to be so.  
23 But as I mentioned, I believe in my discussion with Ms.  
24 McClenaghan, the derived emissions limits are not based  
25 on what the inventory is, they are based on some sort

1 of a risk-based limit, in this case, the public dose  
2 limits.

3 So I guess you could be arguing that we  
4 don't need a DEL for HT at Darlington, but it's  
5 provided for completeness.

6 Q. And Dr. Whillans, even Hydro's, and I  
7 take it it's AECB's target of 1 per cent of DEL allows  
8 the loss of one-third of the total contents of the  
9 facility over a year; would that be fair?

10 A. I think that's approximately right.

11 THE CHAIRMAN: Could you repeat that  
12 question for me again, please.

13 MR. MATTSON: Yes, Mr. Chairman.

14 Hydro's target of 1 per cent of DEL  
15 allows the loss of one-third of the total contents of  
16 the facility over a year.

17 THE CHAIRMAN: Why do you say that's  
18 correct? What process do you go through to say that's  
19 correct?

20 DR. WHILLANS: Well, I think we agreed  
21 that the content of the facility was about 1.2 by 10 to  
22 the 8th curies at sometime in the future, not in 1990,  
23 but when it has reached the point where it has  
24 maximally extracted from tritium from all you other  
25 reactors. That was from one of the tables that we

1 referred to. And 1 per cent that have would be 1.2  
2 times -- sorry, you said one-third.

3 MR. MATTSON: Q. That's correct.

4 DR. WHILLANS: A. One-third of that  
5 would be 4 times 10 to the 7th curies, and Mr. Mattson  
6 is pointing out that the DEL, 1 per cent of the DEL is  
7 1.2 times -- sorry. The DEL is 3.6 times 10 to the 9th  
8 curies per year.

9 THE CHAIRMAN Yes.

10 DR. WHILLANS: Maybe you can remind me  
11 what your point was.

12 MR. MATTSON: Q. Hydro's target of 1 per  
13 cent of DEL allows the loss of one-third of the total  
14 contents of the facility over a year.

15 DR. WHILLANS: A. Right. So it's the  
16 comparison of 3.6 by 10 to the 9, with 4 by 10 to the  
17 7, which is about 1 per cent.

18 Q. My follow-up question, Dr. Whillans,  
19 or anybody else on the panel actually, is this target  
20 really as low as reasonably achievable?

21 A. Perhaps you could point me to the  
22 place where it shows that we use a 1 per cent target  
23 for elemental tritium.

24 Q. Well actually if you don't, maybe is  
25 there another target that you use?

1                   A. Well, certainly 1 per cent is the  
2                   number we have quoted for our tritiated water and for  
3                   our other emissions.

4                   Myself, I am not aware that we have  
5                   indicated a target of 1 per cent for HT for the reasons  
6                   that you have described.

7                   Q. Is the 1 per cent not in the station  
8                   operating principles and practices?

9                   A. For HT?

10                  Q. For DELs?

11                  A. One per cent is certainly in the  
12                  OP&Ps for DELs.

13                  Q. Would that not include HT, Dr.  
14                  Whillans?

15                  A. I think the problem that we have here  
16                  is that 1 per cent is meant to be a target which we  
17                  will work down to. I don't think there is ever an  
18                  implication that we will try to work up to it by buying  
19                  outside HT, or something like that.

20                  The 1 per cent is generally with  
21                  reference to the nuclides for which we have higher  
22                  inventories and we will work down to a target of 1 per  
23                  cent at least. I don't think there is ever the  
24                  implication that if we have much less we will be more  
25                  careless with it.

1 Q. But is it not your evidence that you  
2 only filter to get to that target when you are going to  
3 be above it?

4 A. I don't know that we filter for HT.  
5 Are you referring to --

6 Q. Active liquid waste.

7 A. You are talking primarily about  
8 airborne escape with HT.

9 THE CHAIRMAN: We have been talked up to  
10 now about air, not water emissions; is that not right?

11 DR. WHILLANS: We have been talking about  
12 airborne emissions, that's right.

13 The 1 per cent applies generally to both  
14 but in this case we are only talking about airborne  
15 emissions.

16 And active liquid waste, I'm sorry, I am  
17 not terribly familiar with control, but I don't think  
18 that -- we are generally talking about airborne  
19 emissions.

20 MR. MATTSON: Q. Dr. Whillans, just  
21 going back to general principles, because that's really  
22 what I am trying to discuss here. Is there another  
23 target that we should be looking at other than the 1  
24 per cent one that you are aware of?

25 A. Well, as I said, our target is to



1 stay below 1 per cent. It doesn't mean we can't stay  
2 below 10 to the minus 4 if ALARA makes it reasonable to  
3 do so.

4 Q. And is your treatment of HT as low as  
5 reasonably achievable?

6 A. Perhaps Mr. Johansen knows more about  
7 the HT control.

8 MR. JOHANSEN: A. First of all, harking  
9 back to the discussion that I had with Ms. McClenaghan  
10 about the active liquid waste management system and the  
11 extent to which we filter and ion exchange and treat in  
12 general before pump out, that was a discussion that I  
13 think focused to a large extent on beta gamma, the  
14 other non-carbon-14 nuclides.

15 What I would like to point out is that  
16 the actual emissions that we have documented, in fact  
17 it was included in my direct evidence, in Exhibit 519,  
18 at page 49, although admittedly the TRF has not been in  
19 operation that long, the emissions have been much less  
20 than the 1 per cent operating target.

21 Now, you might argue reasonably that that  
22 doesn't prove a heck of a lot since we are only in the  
23 embryonic stage of operation of that facility, I guess,  
24 but I just wanted to make that point.

25 The other point which I think needs to be



1 mentioned is that there is no complacency about this  
2 issue. We do not assume that because we have the legal  
3 right, if you will, to admit up to - what was it - 3.6  
4 times 10 to 9, that we will be doing so or even 1 per  
5 cent of that.

6 There is ongoing research and development  
7 and there are feasibility studies under way to look at  
8 ways of, first of all, better detection of carbon-14,  
9 and secondly, if the technology can be demonstrated to  
10 be effective and cost-effective, I alluded to this  
11 before, then that might be applied as well.

12 Although that is primarily focused on HTO  
13 emissions from the stations, I would expect that some  
14 of that would be applicable to the TRF as well.

15 So, I think Dr. Whillans has put the  
16 issue of carbon-14 in both local and global perspective  
17 earlier, I think that's suggests that there is not an  
18 urgency to come up with a crash solution.

19 On the other hand, we are not complacent  
20 about it and we are seeking, because of its very long  
21 half life, to come up with a reasonable way of  
22 mitigating the very low emissions that we do have.

23 DR. WHILLANS: A. Maybe I can comment on  
24 why the DEL for HT is so much higher than for HTO.  
25 With Ms. McClenaghan I think we were discussing a

1 number of 600 and that's basically the ratio of the  
2 DELs found in table 1 on page 130.

3 In fact, the inherent toxicity, if I can  
4 use that term, of HT, that is the dose per unit intake,  
5 is more than 10,000 times less than for HTO because  
6 it's essentially hydrogen, it's not very soluble and it  
7 basically goes into the body for a short time and only  
8 a fraction of it stays.

9 So the 600 factor is based on something  
10 other than the toxicity. If you were basing it just on  
11 the toxicity alone it would be 10,000 times larger.  
12 And I think that may be the route of our discussion  
13 here, that the value is very high for HT because it's  
14 quite a non-toxic substance.

15 Q. Well, until it converts in two days,  
16 first of all.

17 A. Over some period of time.

18 The 600 is based on toxicity from the HTO  
19 that results after conversion in the environment and we  
20 talked about that yesterday.

21 Q. A lot of this we discussed yesterday.

22 My simple question is: Is it Ontario  
23 Hydro's position that the 1 per cent target is as low  
24 as reasonably possible or achievable, or not?

25 A. No, that's the upper -- sorry.

1                   Maybe you can comment.

2                   That's the upper limit, to be below 1 per  
3 cent. And we can operate below that if ALARA indicates  
4 that it is reasonable.

5                   Q. And that's what I am asking.

6                   A. Sorry?

7                   Q. Is there a target that's lower than  
8 that that's reasonable?

9                   MR. JOHANSEN: A. It's been questioned.

10                  I don't think that we can say right now  
11 that our position is that it is reasonable or is it  
12 equivalent to ALARA. We in fact are examining whether  
13 the application of ALARA to this particular issue  
14 should result in some reduction. So that's the best we  
15 can say, is that we are questioning it.

16                  DR. WHILLANS: A. I think what you  
17 should ask is whether the operation of the TRF is  
18 reducing emission of tritium to the environment, and I  
19 think unquestionably it is. And then secondary  
20 question is, is the TRF being operated in an optimal  
21 way. And you are pointing out that it might not be  
22 difficult for us to emit even less and you may be  
23 right. But we are talking about a very small  
24 contribution to the dose commitment.

25                  Q. Dr. Whillans, if you turn to page 127

1 of our exhibit, the graph that we are speaking of,  
2 tritium emissions to air, an attachment interrogatory,  
3 2.2.8.

4 A. Yes.

5 Q. If we look at Darlington Elemental we  
6 see under annual emissions in curies, under 1988 1.6  
7 times 10 to 5th; 1989, 6.2 times 10 to the 4th. Those  
8 numbers appear to me to be larger than all the other  
9 numbers above dealing with Pickering and Bruce; is that  
10 correct?

11 A. I just pointed out to you that if you  
12 just look at the curie basis you are not including the  
13 fact that elemental tritium is 10 to the 4th times less  
14 toxic.

15 Q. For a few days.

16 A. For a few days. Well, as long as it  
17 remains as elemental tritium it's less toxic. If it  
18 converts to tritiated water then it has the same  
19 toxicity as tritiated water, yes.

20 As you know also, the DELs, even for the  
21 same nuclide, will vary from one station to the other,  
22 and that is because distribution of population or other  
23 factors mean that the doses to the public will be less  
24 for a higher level of emission, and that could be one  
25 factor in why these vary.

1 Q. Dr. Whillans, then with respect to  
2 what you have said, that the total emissions, the TRF  
3 at Darlington has lead to lower emissions to the  
4 environment of tritium, in light of that graph on page  
5 127 of the exhibit, can you really say that?

6 THE CHAIRMAN: You mean table not graph.

7 MR. MATTSON: Yes, table, Mr. Chairman.

8 DR. WHILLANS: First, I don't think I  
9 said that the TRF has lead to significantly lower  
10 emissions.

11 I pointed out that it has been operating  
12 for a few years but we have had significant problems.  
13 It hasn't been operating full-time, and I think that's  
14 probably why the 1988 emissions were much greater than  
15 '89 and 90, it hasn't been operating full-time during  
16 this period. However, it has begun to remove tritium  
17 from the other stations, and to that extent has reduced  
18 their emissions. In the long term, which is what we  
19 are talking about when we are comparing 120 megacuries  
20 of inventory, it will have removed that from the other  
21 stations and reduced their emissions.

22 [10:40 a.m.]

23 MR. MATTSON: Q. Dr. Whillans, would you  
24 agree that the DEL for tritium from the TRF is larger  
25 than the corresponding DELs from all Hydro's nuclear



1 stations combined? The target level we know Hydro  
2 controls its emission to is also larger than the  
3 corresponding targets from all Hydro's nuclear  
4 stations?

5 DR. WHILLANS: A. You are talking about  
6 the entry 3.6 by 10 to the 9th, compared with the sum  
7 of the other emissions?

8 Q. Yes.

9 A. Well, I guess you are right, but here  
10 is where I have a problem, because your punchhole went  
11 through the data, but I suspect you are right, yes.

12 Q. Is there anybody else on the panel  
13 where the punchhole didn't go through that?

14 A. It is only through the Darlington  
15 oxide, and that is probably not any different from the  
16 others. So I will agree generally, yes, the emission  
17 of tritium in the form of L-metal tritium from the TRF  
18 at the DEL can be higher than all the others, yes - for  
19 the reasons we have just talked about.

20 Q. Thank you. This question is for  
21 whoever on the panel wants to answer it, but does  
22 anybody have any idea of the ratio of heavy water to  
23 light water in the ALWMS pumpouts?

24 MR. JOHANSEN: A. I don't have that  
25 information readily available.



1 Q. And no one else? In the relatively  
2 few tankfuls or pumpouts that are most contaminated  
3 with D2O, first of all, maybe you could explain what  
4 D2O is?

5 A. Deuterium oxide.

6 Q. Thank you. And in the relatively few  
7 tankfuls of pumpouts that are most contaminated with  
8 D2O, do you have any idea what the ratio is?

9 THE CHAIRMAN: Ratio, sorry, of what?

10 MR. MATTSON: Q. Heavy water to light  
11 water?

12 MR. JOHANSEN: A. It would be a very  
13 small fraction, I'm sure. But again, I don't have that  
14 data readily available.

15 Q. Would it be fair to say, Mr.  
16 Johansen, that the quantities of tritium that Hydro  
17 pumps into Lake Huron and Lake Ontario are all  
18 associated with heavy water pumped or leaked into the  
19 lakes?

20 A. Pumped from the active liquid waste  
21 management system, yes. And leaked, you say? There  
22 are occasional leaks from other pathways or other  
23 effluent streams at the plant which upon detection then  
24 are controlled, but certainly from time to time, as we  
25 have indicated before in direct and cross-examination,

1       that would be another source.

2                   Q.   And, Mr. Johansen, wouldn't every  
3       single tankful of water you pump into the lake have a  
4       heavy water content that is higher than the lake water?

5                   A.   Well, if there is tritium content in  
6       the effluent, yes, that would be in a concentration  
7       greater than ambient concentration in the environment,  
8       yes.

9                   Q.   And Ontario Hydro - your pure heavy  
10      water, you get that in effect by extracting it from the  
11      lake water from Lake Huron; correct?

12                  A.   That's correct.

13                  Q.   And this is an expensive process, an  
14      energy-intensive process?

15                  A.   It is expensive, yes.

16                  DR. CONNELL:   Just back up for a minute.

17                  Mr. Mattson, you asked about heavy water,  
18      and you answered with respect to tritium. Did I miss  
19      something?

20                  MR. MATTSON:   Q.   Is tritium a marker for  
21      heavy water?

22                  MR. JOHANSEN:   A.   Well, you were talking  
23      about tritiated heavy water, I presume?

24                  Q.   Yes.

25                  DR. WHILLANS:   A.   Except in the TRF

1 process, we don't attempt to separate tritium once it  
2 is formed in the heavy water. So they are going to be  
3 mixed at the stations.

4 Q. Has Hydro done any analysis of the  
5 financial and energy-saving benefits that might come  
6 from in effect mining or recycling this rich sort of  
7 heavy water or deuterium in its ALWMS, which is the  
8 Active Liquid Waste Management System?

9 MR. JOHANSEN: A. Not in the context  
10 that your question was put.

11 There certainly have been illustrative or  
12 formal applications of the ALARA principle in which the  
13 economic value of heavy water saved was either partly  
14 or exclusively used as the justification for some  
15 control action, for example the installation of  
16 additional dryers at Bruce, but I believe there is an  
17 example of that sort of calculation in the ALARA  
18 guideline document which I referred to yesterday which  
19 was provided in the interrogatory process.

20 Q. Can you just point that guideline out  
21 to me?

22 A. Yes, it was Interrogatory 9.6.46.

23 Q. And is that an Ontario Hydro  
24 document?

25 A. Yes, it is. However, I might add

1 that the fact that a control action may be justified  
2 purely on the economic savings is a convenience. It  
3 means that you don't then need to go on to the somewhat  
4 more difficult calculation, including evaluation of  
5 very subjective factors in justifying some control  
6 action.

7 Q. Thank you. Now, if you turn to page  
8 12 of the exhibit, it is an Atomic Energy Control Board  
9 document, entitled Radioactive Release Data From  
10 Canadian Nuclear Generating Stations, 1972 to 1988,  
11 dated January, 1990.

12 Is anyone on the panel familiar with this  
13 document?

14 THE CHAIRMAN: Perhaps we should have an  
15 exhibit number for it.

16 THE REGISTRAR: 622.

17 THE CHAIRMAN: Thank you.

18 ---EXHIBIT NO. 622: Atomic Energy Control Board  
19 document, entitled Radioactive Release  
20 Data From Canadian Nuclear Generating  
Stations, 1972 to 1988, dated January,  
1990.

21 MR. JOHANSEN: I'm sorry, the question  
22 was: Is anyone familiar with that document?

23 MR. MATTSON: Q. Yes.

24 MR. JOHANSEN: A. I think a number of us  
25 probably are familiar with these kinds of documents,

1 but personally I haven't recently read every line of  
2 it.

3 MR. MATTSON: All right. Mr. Chairman,  
4 just for the record that is from page 12 to page 35 of  
5 the exhibit.

6 THE CHAIRMAN: It is all part of the  
7 same, is it?

8 MR. MATTSON: Yes.

9 THE CHAIRMAN: All right. Thank you.

10 DR. WHILLANS: I am generally familiar  
11 with it.

12 MR. MATTSON: Q. Thank you, Dr.  
13 Whillans.

14 Now, if you would turn to page 17 of that  
15 exhibit.

16 DR. WHILLANS: A. This is page 17 of  
17 your exhibit?

18 Q. Yes.

19 A. Right.

20 Q. I usually refer to my exhibit in  
21 black bold letters in the top right-hand corner.

22 Dr. Whillans, first of all, this is the  
23 derived emission limits for gaseous effluents is the  
24 table, and the derived emissions limit from liquid  
25 effluents; do you see that?



1 A. Yes, I do.

2 Q. And at the moment I am dealing with  
3 Darlington, down around 7?

4 A. Yes?

5 Q. And can you confirm that the derived  
6 emission limits for liquid effluents at Darlington for  
7 both tritium and for gross beta are significantly  
8 higher than for any other station except Point Lepreau  
9 in New Brunswick, which is the highest by far for  
10 tritium?

11 A. Well, according to this table the  
12 Darlington gross beta liquid DEL is higher than any of  
13 the other ones listed, and for tritium it is higher  
14 than all the others except for Point Lepreau, and there  
15 is a note explaining why the Lepreau DEL is high.

16 Q. Dr. Whillans, could you read that  
17 footnote into the record?

18 A. Footnote No. 3?

19 Q. Yes.

20 A. The DEL for tritium and liquid  
21 effluent at Point Lepreau is much higher  
22 than for other stations. This is because  
23 the effluent goes to salt water, and  
24 hence, drinking water is not a pathway to  
25 man.



1 Q. And, Dr. Whillans, is this footnote  
2 with respect to emissions to salt water not as  
3 important, is it because it is not worth abating these  
4 emissions because man doesn't drink the salt water;  
5 would that be fair?

6 A. Well, I think any of the DELs is  
7 based on likely pathways to man, and so that would be  
8 the case: not many people drink salt water.

9 Q. So this would be an illustration of  
10 the "humans only" philosophy with respect to setting  
11 these links.

12 A. Well, of course, that is a simple  
13 answer because water does evaporate from the oceans and  
14 it falls as fresh water, so it doesn't isolate it from  
15 human exposure. But then you have to take into account  
16 the probabilities that the emissions by that pathway  
17 will eventually expose humans.

18 Q. But that philosophy would not take  
19 into account, then, any of the non-human living  
20 organisms that live in that salt water, correct, unless  
21 we eat them?

22 A. Well, I am not familiar in detail  
23 with the Lepreau DEL document, but I would think that  
24 is probably the case, yes.

25 Q. Now, still on page 17 and we are

1 looking at Darlington, Darlington's DEL for tritium, I  
2 would say it is relatively huge, and the gross beta,  
3 the result of Hydro's building a long diffuser pipe, a  
4 kind of underwater superstack out into Lake Ontario at  
5 Darlington, is that the reason why it can be so large?

6 A. Well, I am not familiar with the  
7 diffuser. Perhaps Mr. Johansen can...

8 Q. Mr. Johansen, the reason why the  
9 Darlington tritium, carbon-14 and gross beta, why those  
10 limits are so huge compared to the other ones on the  
11 graph, is that because of the underwater superstack or  
12 the diffuser?

13 A. Carbon-14 is smaller actually than  
14 Pickering.

15 Q. Okay.

16 A. Sorry, that is the end --

17 Q. Gaseous.

18 A. That is the gaseous, right.

19 Q. Yes.

20 MR. JOHANSEN: A. Well, I can't say if  
21 it is the dominant factor, but clearly, the discharge  
22 system is different at all of our plants, and at  
23 Darlington it happens to be an offshore point of  
24 discharge, which is different from any of the other  
25 plants. That may account for some of the difference.

1 Q. And when you say "different" it is  
2 much longer out into the lake than Pickering on Bruce?

3 A. It is offshore. All of the others  
4 are onshore.

5 Q. And it is this diffuser pipe that  
6 allows the limits, superstack as they call it, that  
7 allows these limits to be so large; correct?

8 A. Well, I just said, I am not sure if  
9 that structure is a dominant factor. I haven't seen  
10 the detailed calculation, but I wouldn't doubt that it  
11 is a factor.

12 DR. WHILLANS: A. I would think also the  
13 greater population distribution around Pickering, for  
14 example, would reduce their DEL. So there is a number  
15 of factors.

16 Q. And Bruce, how does that compare?

17 A. Well, Bruce would be probably even  
18 more extreme than Darlington because the population is  
19 sparse.

20 Q. That's right, but the limits don't  
21 reflect that, do they.

22 A. As I say, the setting of the limits  
23 is quite a complicated process, involving analysis of  
24 many pathways.

25 Q. Would you agree that the pipe, the

1 superstack, in conjunction with Ontario Hydro's stated  
2 policy of only filtering to meet the 1 per cent of DEL  
3 limit will generally mean that the filters at  
4 Darlington are used even less frequently than those at  
5 Pickering, which the AECB's '86 report says were used  
6 once in the station's first 15 years?

7 [10:55 a.m.]

8 A. I think Mr. Johansen knows more about  
9 this. But you are talking about filtering for gross  
10 beta now, not filtering for tritium.

11 Q. That's correct.

12 MR. JOHANSEN: A. Well, we are in fact  
13 currently examining the question of whether we should  
14 only use the treatment system when it's judged  
15 necessary to meet the operating target, or whether we  
16 should do so routinely. And that in fact is one of the  
17 issues being looked at in, for example, the Bruce  
18 rehabilitation program, which includes a project to  
19 improve the active liquid waste management system. And  
20 I would anticipate that that sort of review would be  
21 applicable more or less to other stations as well.

22 So again, it's not a static situation.  
23 We are reviewing the feasibility, economics and  
24 benefits of doing what you are talking about.

25 Q. I agree, Mr. Johansen. But when you

1 say it's not static, it's not static because it's  
2 getting worse; correct, the emissions?

3 A. I don't think there is a trend in  
4 that.

5 DR. WHILLANS: A. I point out in our  
6 Exhibit 520.15 that the gross beta gamma emissions to  
7 water from Darlington are not just less than 1 per  
8 cent, but much less, .1 per cent or less, and you have  
9 to keep that in perspective.

10 Q. If you turned on your TRF would they  
11 be lower? Your filters, I mean. If you turned on your  
12 filters would they be lower?

13 MR. JOHANSEN: A. Yes, there is no  
14 question. But the emissions are already low, and they  
15 have been not just at the 1 per cent of the regulatory  
16 limit; they have been well below.

17 So there again, there has not been an  
18 urgency about changing procedures, but the matter has  
19 been raised and discussed with the Atomic Energy  
20 Control Board and we are reviewing the best way of  
21 managing emissions in the future which might well lead  
22 to a reduction in both gross beta gamma and other  
23 emissions.

24 ALARA is a dynamic concept. I can't  
25 remember a period when there wasn't some kind of



1 research and development or ongoing operational review  
2 to reduce emissions.

3 DR. WHILLANS: A. Exhibit 520.15 has  
4 only Darlington data for 1990.

5 If you look at the stations, for example,  
6 Pickering, you have data for the last five years, and  
7 only in one of those years has the gross beta gamma to  
8 water exceeded .1 per cent. In fact, it was almost .01  
9 per cent in 1990. So we are talking about a very small  
10 contribution compared to some of the other emissions.

11 Q. I understand.

12 DR. CONNELL: Could you define gross beta  
13 for me please, Doctor?

14 DR. WHILLANS: Well, Mr. Johansen may  
15 want to improve on this.

16 Basically, the fission products mainly  
17 and some of the activation products that might be found  
18 in waste are generally beta gamma emitters, caesium,  
19 strontium, various things like that. And when the  
20 levels are very low, rather than trying to identify  
21 each individual nuclide, there is generally a  
22 characterization of the group as a whole made to  
23 determine the toxicity and then it's monitored by a  
24 gross measurement which may in some cases be by beta or  
25 by gamma measurement. And basically it is just a term



1 that describes a collection of fission and activation  
2 products, all of which emit beta gamma radiation, as  
3 opposed to alpha radiation.

4 DR. CONNELL: But not including carbon-14  
5 or tritium?

6 DR. WHILLANS: Well, those certainly are  
7 beta emitters, but in this category we are talking  
8 primarily I believe about particulates, filterable  
9 material.

10 THE CHAIRMAN: I'm sorry, I didn't quite  
11 get that. Say that again, please.

12 DR. WHILLANS: I said that certainly  
13 carbon-14 and tritium are beta emitters, so in a sense  
14 they could fall into this category, but generally I  
15 think we are talking about particulate material it  
16 would have included those.

17 DR. CONNELL: And in fact, the  
18 terabecquerels per year are orders of magnitude lower  
19 than the tritium apparently.

20 DR. WHILLANS: You are looking at the DEL  
21 table?

22 DR. CONNELL: For example, page 30, it  
23 shows a graph, it's cut off at the top. This Pickering  
24 "A", I think, the tritium never gets above -- well,  
25 it's up to about 2,000 terabecquerels, whereas gross

1       beta is .1 at the highest.

2                   DR. WHILLANS: That's right. That  
3 reflects the relatively higher toxicity of some of  
4 these other compounds. And all of the measurements  
5 referred to in our environmental summaries are with  
6 respect to the DEL which is essentially a normalization  
7 against toxicity.

8                   So when we talk about 1 per cent for  
9 growth beta gamma, we are talking about -- and  
10 comparing it to 1 per cent, say, for tritium, although  
11 the DELs are very different, those are of essentially a  
12 measure of toxicity. So that's normalized in that  
13 sense.

14                  DR. CONNELL: But whatever detection  
15 method is used, I would guess that it doesn't even  
16 detect tritium beta, otherwise a very small  
17 contamination would --

18                  DR. WHILLANS: That's probably correct,  
19 yes.

20                  MR. MATTSON: Q. Dr. Whillans, just in  
21 response to Dr. Connell's question. Exhibit 606, page  
22 93 of our exhibit, is it correct to say that there is a  
23 discussion of subject of gross beta gamma there?

24                  DR. WHILLANS: A. Your exhibit?

25                  Q. Page 93.

1                   A. 606. Can you remind me what the  
2 title of that exhibit is?

3                   Q. Sure. It was AECB Regulatory  
4 Research Branch, Health Physics Appraisal Report of the  
5 Management of Radioactive Liquid Waste and Liquid  
6 Effluent Monitoring at Pickering Nuclear Generating  
7 Station.

8                   MR. B. CAMPBELL: I think that's Exhibit  
9 597.

10                  THE CHAIRMAN: It's a mixture. It's on  
11 page 93 of 597 but it's actually Exhibit 606, and it  
12 runs from page 93 to 103.

13                  But where is the discussion, Mr. Mattson?

14                  DR. WHILLANS: I'm sorry, which page?

15                  MR. MATTSON: Q. Do you have the  
16 exhibit?

17                  DR. WHILLANS: A. I have the exhibit.

18                  Q. If you turn to page 99 of my exhibit  
19 you will find 7.7.

20                  A. Yes.

21                  Q. You see the discussion there with  
22 respect to beta?

23                  A. Which paragraph are you referring to?

24                  Q. 7.7.

25                  A. Yes. And then there is finding,

1        comments, recommendations, rationale?

2                    Q.    That's right?

3                    A.    The whole...

4                    Q.    It is just in terms of a discussion  
5        of that issue; correct?

6                    THE CHAIRMAN:    It doesn't describe the  
7        gross beta, but it does say it contains recommendations  
8        and comments.

9                    MR. MATTSON:    Mr. Chairman, Mr. Rubin  
10       informs me that it is discussed throughout the report.  
11       I am not able to give you the exact other sites, he  
12       just found one as an example.

13                   THE CHAIRMAN:    You are quite right, it's  
14       throughout the report.

15                   DR. CONNELL:    Well, it does seem to  
16       confirm the observation I made that it's actually  
17       counted as gamma.

18                   DR. WHILLANS:    Sorry, which is counted a  
19       gamma?

20                   DR. CONNELL:    Well, the finding in the  
21       second sentence, the gross gamma analytical results are  
22       then multiplied by a conversion factor and reported as  
23       gross beta gamma counts.

24                   DR. WHILLANS:    I think what we are  
25       referring to here is one method of detecting which

1 appears to rely on the gamma emissions. And I said in  
2 other circumstances, for instance in the laboratory  
3 analysis of environmental samples, they often measure  
4 the beta emissions. In either case, there has to be  
5 some sort of characterization of the group because it  
6 contains betas of many energies and gammas of many  
7 energies, and in different circumstances you might try  
8 to detect them using one method or another.

9 MR. MATTSON: Thank you.

10 Q. Now just to get back to the question  
11 again. Mr. Johansen, back to the original issue. You  
12 don't have to rehabilitate the station to turn on the  
13 filters; is that correct?

14 MR. JOHANSEN: A. No, that's right.

15 But it's a question of sizing, I guess.

16 Q. All right. And at Darlington was the  
17 relaxation of the emissions limits the main benefit of  
18 building the underwater superstack or were there other  
19 benefits?

20 A. Well, the building of the superstack  
21 as you call it - I haven't heard it referred to that as  
22 before - but the offshore discharge system had in my  
23 recollection nothing to do with the dispersal of  
24 effluent from the active liquid management system. It  
25 had everything to do with the protection of what were



1 believed to be valuable fish habitat in the immediate  
2 offshore area of Darlington. And that was the subject  
3 of long and arduous discussions amongst Ontario Hydro,  
4 the Ministry of the Environment and the Ministry of  
5 Natural Resources, and various concepts were looked at  
6 over a couple of years or more.

7 In fact, going back to prior to the  
8 environmental assessment process and into the post  
9 environmental assessment stage, at the time of the  
10 application for permit to discharge water there was  
11 finally a resolution which resulted in that system. I  
12 don't recall this issue of active liquid waste effluent  
13 being mentioned in the discussion at all.

14 MR. KING: A. I was involved in some of  
15 those at that point in time in the licencing of  
16 Darlington and I can confirm what Mr. Johansen is  
17 saying, that to my recollection it had absolutely  
18 nothing to do with the dilution and radionuclides and  
19 hence allowing larger DELs.

20 Q. All right. Thank you, Mr. King.

21 Are any of you on the panel familiar with  
22 Ontario Hydro's role in relocating one of the municipal  
23 water intakes in of the Town of Pickering farther from  
24 the radioactive outfall pipe from the Pickering nuclear  
25 generating station?



1 DR. WHILLANS: A. I am aware, I believe  
2 that it was the Scott plant very near the station was  
3 closed about 1980, but I am not aware that Hydro had a  
4 role in it and what that role was.

5 Q. So no one would have any information  
6 that Hydro paid for that plant, bought that plant?

7 Mr. Penn?

8 A. Since it's at the foot of Brock Road,  
9 I imagine it would have been in within the site  
10 boundary, and that may have been a reason with  
11 Pickering "B", but I really don't know.

12 Q. And what about the new pipe to  
13 Whitby, did Ontario Hydro pay for that pipe?

14 A. I don't know.

15 Q. Mr. Penn?

16 MR. PENN: A. I'm sorry, which pipe are  
17 you talking about?

18 Q. The water treatment plant supply pipe  
19 from Whitby.

20 A. I just don't know. I know we were  
21 involved with supplying water to the fish hatchery, and  
22 I can talk about that, but I am not familiar with any  
23 water treatment plant in the Town of Pickering.

24 DR. WHILLANS: A. I think there have  
25 been a number of changes in the water supply to the

1 area around Pickering in about the same period. There  
2 was the closing of one plant. There is also  
3 interconnections of Oshawa, Whitby, Ajax, Scarborough,  
4 I don't know that Ontario Hydro had anything to do with  
5 those.

6 Q. Thank you.

7 Sorry, Mr. Chairman, just an indulgence  
8 for a moment.

9 Is anyone on the panel aware that uranium  
10 and radium are both on the EMPPL, the environmental  
11 monitoring priority pollutants list, and that Ontario's  
12 environmental regulations for uranium effluents to  
13 surface waters are so much more stringent than the  
14 AECB's DELs?

15 THE CHAIRMAN: Could you give me those  
16 initials against? What was the first group.

17 MR. MATTSON: EMPPL.

18 THE CHAIRMAN: EMPPL.

19 MR. MATTSON: Which stands for  
20 environmental monitoring priority pollutants list.

21 THE CHAIRMAN: And that comes from where,  
22 what is the source of that?

23 MR. MATTSON: I believe it's an Ontario  
24 provincial government regulation.

25 MR. JOHANSEN: Mr. Chairman, I just

1       happened to turn it up. It appears at 157 of these  
2       materials.

3               MR. MATTSON: Yes, we have included  
4       excerpts of it at page 157 of our exhibit.

5               THE CHAIRMAN: It's already been put in  
6       as Exhibit 407, and it runs from page 157 to 164. I  
7       think we referred to it earlier.

8               MR. MATTSON: Thank you, Mr. Chairman.

9               Q. Mr. Johansen or Dr. Whillans, one  
10       problem with the exhibit is it doesn't include the  
11       list, but are you aware that radium and uranium are on  
12       that list?

13              DR. WHILLANS: A. I'm sorry, I am not  
14       familiar with this list.

15              Q. Mr. Johansen?

16              MR. JOHANSEN: A. I am generally aware  
17       of the list, I am not sure where exactly on the list  
18       these -- it doesn't surprise me that these these would  
19       be on the list, for one thing, but I also note that  
20       there are at least two categories in the list, one  
21       category being those substances about which a lot is  
22       known. It is pretty certain that they are indeed  
23       toxic. And there is at least one other category which  
24       are on there, to be prudent, I suppose, whilst the jury  
25       is out, pending confirmation on the basis of further

1 research, and without actually looking at it I wouldn't  
2 be able to say what category those two substances are  
3 in.

4 Q. Thank you, Mr. Johansen.

5 Are you aware that the AECB has stopped  
6 calculating water borne uranium DELs for the uranium  
7 refinery at Port Hope?

8 A. No, I wasn't aware of that.

9 Q. All right. I am going to move on to  
10 some other part of the exhibit, it's at page 234.  
11 There is a series of correspondence with respect to an  
12 issue originally brought up at the Department of  
13 Environment, and our collection of documents are  
14 included in the exhibit from page 227 to 295.

15 Is anyone on the panel familiar with this  
16 issue with respect to the environmental codes of  
17 practice which were planned to apply to environmental  
18 principles equally to all steam electric power  
19 generation facilities, fossil and nuclear?

20 A. I am certainly well aware of the  
21 codes of practice. In fact, I referred to them in my  
22 direct evidence.

23 THE CHAIRMAN: Again I suppose I should  
24 know, but whose codes of practice are these?

25 MR. JOHANSEN: These are codes of

1 practice issued by Environment Canada.

2 There always was the intention to cover  
3 all major phases in the lifecycle of a thermal or a  
4 nuclear plant beginning with the siting phase and that  
5 code of practice has been issued.

6 The design face which in fact was issued  
7 prior to any of the others, came along in 1985, I  
8 believe it was. The construction phase document was  
9 issued somewhat later, I believe in about 1990.

10 The operating phase and the  
11 decommissioning phase documents are in progress at the  
12 moment, and I believe Environment Canada expects those  
13 to be issued sometime later this year.

14 [11:14 a.m.]

15 So I am generally aware of the quota  
16 practice system which Environment Canada has been  
17 developing for some time.

18 THE CHAIRMAN: Did you give a date for  
19 the siting phase?

20 MR. JOHANSEN: I believe it was a year or  
21 two after the design phase code, Mr. Chairman, which  
22 would make it...

23 THE CHAIRMAN: Around 1987?

24 MR. JOHANSEN: About '87, I think sounds  
25 right.



1 MR. MATTSON: Q. Now, Mr. Johansen, I  
2 would like to turn you to a number of Ontario Hydro's  
3 documents that reflect, and I would like to know if  
4 they still reflect, Ontario Hydro's position with  
5 respect to these environmental codes of practice. And  
6 first at page 234 you find a letter--

7 MR. JOHANSEN: A. Yes?

8 Q. --to D.W. Draper, Environment Canada,  
9 from G.A. Vivian from Ontario Hydro; do you see that?

10 A. Yes, I see that.

11 Q. And on 234 it states: This is a  
12 notice of intent, environmental codes of practice,  
13 steam electric power generation?

14 A. Yes.

15 Q. Okay. And if you go to the bottom of  
16 the page --

17 MR. B. CAMPBELL: This is the January,  
18 '82 letter?

19 MR. MATTSON: That's correct. This is  
20 the prehistory to the actual Code.

21 Q. You note at the bottom of the page:  
22 The difference between the two approaches is  
23 substantial -- well, it first sets out the approaches;  
24 is that correct?

25 I can read the paragraph, 1B. I will



1 read this into the record:

2 You failed to mention the limitations  
3 on the application of this Code within  
4 the federal jurisdiction specifically as  
5 they apply to nuclear electric generation  
6 where the guidelines and the regulations  
7 are established by the Atomic Energy  
8 Control Board and the Atomic Energy  
9 Control Act, not Environment Canada.

10 The relationship of your proposed  
11 guidelines to those of the AECB and the  
12 international standards, ICRP, on  
13 radiological emissions, including the  
14 ALARA principle, should be made clear.  
15 The difference between the two approaches  
16 is substantial, has been well defined in  
17 deliberations of the radioactivity work  
18 group 5-2 in correspondence from AECB to  
19 you.

20 And then if I could just turn to the next  
21 page of that letter, point No. 2, entitled At Least As  
22 Stringent:

23 This implies these codes are the  
24 minimum requirement that must be met. In  
25 my view, this position is inaccurate, is

1 unacceptable, and is without  
2 justification and contradicts other  
3 federal standards as guidelines; example,  
4 radiological standards. We do not accept  
5 your best practical technology  
6 radiological approach as a justification  
7 for establishing environmental criteria.

8 Do you see that?

9 MR. JOHANSEN: A. Yes, I see that.

10 Q. And is that a fair characterization  
11 of Ontario Hydro's position at that time?

12 A. Well, it was certainly clearly the  
13 position of Mr. Vivian. I really can't comment very  
14 much on what it says. I guess it speaks for itself.

15 But I would question really whether there  
16 was a good common understanding of what the best  
17 practical technology approach really entailed. I  
18 really can't...

19 In my personal view, applying best  
20 practical technology rigorously would exclude  
21 consideration of economics, and if that indeed was the  
22 understanding between the parties at the time then I  
23 suppose Mr. Vivian was justified in questioning that.

24 But I also know that these terms tend to  
25 get used somewhat loosely, and in the minds of some at

1 the time, I wasn't directly involved, but I remember  
2 that some expressed the view at the time that there  
3 wasn't really all that much difference in the intended  
4 application or the intended approach.

5 I believe that staff at Environment  
6 Canada when they were talking about best practical  
7 technology in fact implied some intent to consider  
8 economics. It simply wasn't explicit in the simple  
9 label Best Practical Technology, and I think that is  
10 probably what concerned Mr. Vivian and others who were  
11 reviewing the issue.

12 But that is purely a personal sort of  
13 after-the-fact observation, not a comment based on  
14 direct involvement at the time because, as I say, I  
15 wasn't.

16 Q. But it is fair to say that concern  
17 was with respect that it didn't concern a cost/benefit  
18 analysis; correct?

19 THE CHAIRMAN: Well, it doesn't say that.

20 MR. MATTSON: No, no. I understand.

21 Q. Your concern, Mr. Johansen.

22 MR. JOHANSEN: A. Well, I think if I  
23 understood the paragraph that you had read earlier, I  
24 think implied in there was the view of Ontario Hydro,  
25 at least as expressed by Mr. Vivian, that the

1 philosophy of ALARA, which does imply a consideration  
2 of economic and social factors, was considered to be  
3 the appropriate approach for control of emissions, and  
4 that there was probably a good deal of concern about  
5 justification for a radical departure from that  
6 approach when emissions were already at a low level.

7 I think that is my observation, and I  
8 think it is not an unreasonable observation.

9 Q. All right. And, Mr. Johansen, it is  
10 true, however, that the more stringent guideline would  
11 be the best practical technology as opposed to the  
12 ALARA principle; correct?

13 THE CHAIRMAN: I'm sorry, I didn't follow  
14 that.

15 MR. B. CAMPBELL: Mr. Chairman.

16 MR. MATTSON: No, it is not in the  
17 documents. It is a question.

18 THE CHAIRMAN: Just repeat the question.  
19 I am not sure what you are saying.

20 MR. MATTSON: Q. That the more stringent  
21 of the two, between ALARA and the best practical  
22 technology, would be the best practical technology,  
23 more stringent in terms --

24 THE CHAIRMAN: You have to define what  
25 best practical technology means before you can even

1       make that comparison.

2                   MR. B. CAMPBELL: Mr. Chairman, if you go  
3       to the next page it is clear that, for instance, when  
4       the Atomic Energy material in my friend's own exhibit  
5       that he has produced, that would lead one to the  
6       conclusion that the difference may be apparent or real,  
7       go to page 236 there is a letter from someone at the  
8       Atomic Energy Control Board saying that the difference  
9       may be apparent or real.

10                  I think if my friend is going to ask  
11       questions where he is asking to comment on a very  
12       particular use of a terminology at a particular point  
13       in time he has an obligation to provide an explanation  
14       of what the use is and the understanding is at that  
15       point in time.

16                  MR. MATTSON: That's fair.

17                  THE CHAIRMAN: That is saying the same  
18       thing. I think before he asks the question he should  
19       say what he understands best practical technology to  
20       mean.

21                  MR. MATTSON: Thank you, Mr. Chairman. I  
22       apologize. I had hoped that I set the foundation in  
23       terms of this cost/benefit analysis that ALARA  
24       requires, and that this is something -- I will ask the  
25       question.



1                   Q. And, Mr. Johansen, as far as Ontario  
2 Hydro is concerned, when the term best practical  
3 technology is used as it was used in setting these  
4 guidelines it does not include a cost/benefit analysis;  
5 correct?

6                   MR. JOHANSEN: A. Well, if interpreted  
7 in the strict sense I believe that would be true. That  
8 would be our interpretation, that economic analysis  
9 would not necessarily be part of that sort of  
10 justification, and, in our view, that would not be  
11 realistic, given the circumstances pertaining to this  
12 discussion.

13                   We are talking about low level emissions;  
14 we are not talking about a situation in which a serious  
15 pollution problem exists that needs to be redressed  
16 ASAP.

17                   DR. WHILLANS: Excuse me, are we  
18 distinguishing between best practical technology and  
19 best available technology?

20                   MR. MATTSON: Q. Yes, we are talking  
21 about best practical technology, which is --

22                   DR. WHILLANS: A. It seems to me that  
23 practical implies some consideration of what is  
24 practical, and so it is not all that different from  
25 ALARA, in my view.

1 MR. JOHANSEN: A. Well, I would add that  
2 if we are going to sort of interpret these things now  
3 the way they are often considered I would say that  
4 practical in many views includes some consideration of  
5 economics and technical feasibility.

6 But I believe in the original definition  
7 of best practical or best practicable it was merely a  
8 concept of justifying emission control on the basis of  
9 proven technology; in other words, simply answering the  
10 question: Does it work?

11 THE CHAIRMAN: I realize that everybody  
12 seems to think there is some great significance in  
13 ALARA and this practical and BAT and goodness knows a  
14 number of other things, and I hesitate to enter this  
15 sacred ground, but it seems to me that we have had very  
16 clearly what the approach of the proponent is to the  
17 emission levels, and that that philosophy may not be  
18 the right philosophy or may not be the philosophy that  
19 they should have, but I think they have made clear what  
20 it is.

21 Whatever kind of label they put on it I  
22 think perhaps is not really a very useful exercise  
23 because it is really a semantical exercise and you  
24 really have to know what the defined terms are before  
25 you can compare them.

1 MR. MATTSON: I appreciate that, Mr.  
2 Chairman.

3 The only reason that I am pursuing this  
4 course of cross-examination is to try and compare what  
5 we perceive to be an environmental approach versus  
6 another, but I understand that I have to put a  
7 definition to him.

8 THE CHAIRMAN: Well, Hydro does say for  
9 matters which they do not consider to be serious, if I  
10 heard Mr. Johansen correctly - and that may be another  
11 category - then, they consider economic and social  
12 factors to be relevant in considering whether to adopt  
13 a particular technology.

14 MR. MATTSON: Thank you, Mr. Chairman.

15 Q. Maybe, Mr. Johansen, I can put to you  
16 just the definition of the problems with best practical  
17 technology which is set out at page 239 as expressed by  
18 Atomic Energy of Canada Ltd. and ask you if Ontario  
19 Hydro would agree with that.

20 This is a letter addressed to Mr. Draper  
21 of Environment Canada, from Liberty Pease, Chief  
22 Engineer, Safety Engineering at AECL. You will note  
23 the first paragraph:

24 I am responding to your notice of  
25 January 12th, 1982, of the intent to

1 issue the design phase manual of the  
2 Environmental Code of Practice for steam  
3 electric generating stations.

4 And if you would go down the page:

5 I would, however, add comment to the  
6 issue of best practical technology versus  
7 ALARA. Though I am in general agreement  
8 with what they say...

9 It gives the first objection, and then if I could just  
10 read the second one and ask you Ontario Hydro's  
11 position with respect to this:

12 The argument against regulating to  
13 specific emission levels - namely, that  
14 it permits present industries to consume  
15 the available environmental tolerance and  
16 thereby interdicts the creation of new  
17 technologies - may be saying more about  
18 the limits prescribed than about the  
19 method itself.

20 Furthermore, it is hard to accept a  
21 proposition which says in effect that  
22 present generations should not pollute so  
23 that future generations may do so. Not  
24 only do I see no particular obligation on  
25 the part of the present generation for

1 the comfort of future generations, but I  
2 also think we underestimate the ingenuity  
3 of future generations to control  
4 pollution from technologies they devise.  
5 Would that be one difference, in your  
6 view or Ontario Hydro's view, between best practical  
7 technology and ALARA?

8 MR. JOHANSEN: A. No, I don't think so.

9 This appears to be, well, in fact, it  
10 explicitly indicates that it is a personal opinion of  
11 Mr. Pease, and I guess my personal opinion in looking  
12 at this is that while I wouldn't agree with the latter  
13 part of his last sentence - that is, I do agree that we  
14 probably underestimate the ingenuity of future  
15 generations and the ability of new evolving technology  
16 to control pollution in future - however, I don't think  
17 we can bank on that, so for that reason I really can't  
18 agree with the first part of the sentence.

19 And indeed, the regulatory system that we  
20 work under particularly for management of long-lived  
21 radioactive materials, used fuel, and -- used fuel is  
22 what I am thinking about primarily, does explicitly  
23 require us to be concerned about future generations.

24 So I don't know exactly the corporate  
25 position on this, but I would be very doubtful that it



1 would line up with this.

2 Q. Does anybody on the panel agree with  
3 the comments of the AECB employee in full?

4 Mr. Chairman, maybe we could take a break  
5 then and start a new area?

6 THE REGISTRAR: Please come to order.

7 This hearing will recess for 15 minutes.

8 ---Recess at 11:30 a.m.

9 ---On resuming at 11:55 a.m.

10 THE REGISTRAR: Please come to order.

11 This hearing is again in session. Be seated, please.

12 THE CHAIRMAN: Mr. Mattson?

13 MR. MATTSON: Thank you, Mr. Chairman.

14 Q. Mr. Johansen, you said at one point  
15 in the evidence that the U.S. Academy of Sciences  
16 Committee on biological effects of ionizing radiation,  
17 or BEIR, studied the effects of radioactive emissions  
18 on the natural environment. Do you recall that?

19 MR. JOHANSEN: A. Yes, I do.

20 Q. And really I am just interested in  
21 where they did say that in that document, where it was  
22 dealt with the in the BEIR Committee?

23 A. I believe it's paragraph 16. I can't  
24 cite you page and line number, but...

25 THE CHAIRMAN: What document?

1 MR. MATTSON: Q. Is that an exhibit at  
2 the hearing, BEIR?

3 MR. JOHANSEN: A. There was a question  
4 about that. I don't recall it being made an exhibit.

5 DR. WHILLANS: A. Excuse me, I think  
6 there may be some confusion.

7 Paragraph 16 of the ICRP document refers  
8 to the --

9 MR. JOHANSEN: A. Yes, that's what I was  
10 thinking. I apologize.

11 Q. And then transcript 122, and I can  
12 refer to you the page, 21317, at line 18 you  
13 included --

14 THE CHAIRMAN: Wait a minute.

15 MR. MATTSON: Sorry, Mr. Chairman.

16 MR. JOHANSEN: Page number again was?

17 MR. MATTSON: Q. 21317.

18 MR. JOHANSEN: A. Yes. And the line  
19 number?

20 Q. Line 8. The question was:

21 As we heard from Dr. Whillans, we  
22 dealt with the health effects, his  
23 evidence dealt with human effects, but I  
24 to know from you how these emissions have  
25 affected the natural environment.

1 And this is in direct from Ms. Harvie.

2 You indicated:

3 This is a question which has recently  
4 been studied by a number of international  
5 scientific bodies that Dr. Whillans  
6 referred to, including the UN Scientific  
7 Community on effects of atomic radiation,  
8 or UNSCEAR; the U.S. Academy of Sciences  
9 Committee on the biological effects of  
10 ionizing radiation, or BEIR, as well as  
11 an International Commission on  
12 Radiological Production.

13 MR. JOHANSEN: A. That should be  
14 Protection.

15 Q. Protection, I'm sorry.

16 A. ICRP.

17 Q. Thank you. Is it your evidence then  
18 that that was incorrectly included, the BEIR?

19 A. No. The paragraph that I referred to  
20 was in reference to the ICRP latest document, and it  
21 was my mistake. I was thinking of paragraph 16 in the  
22 ICRP document, not in the BEIR document. I apologize.

23 THE CHAIRMAN: But what Mr. Mattson  
24 wants to know, what is the BEIR document?

25 Is that right?

1 MR. MATTSON: That's correct, Mr.  
2 Chairman.

3 Q. Where does that appear in BEIR?

4 MR. JOHANSEN: A. I can't point to you  
5 exactly where in the BEIR document it appears. All I  
6 was indicating in that statement --

7 THE CHAIRMAN: First of all, there is a  
8 such a document. Can we start with that? There is  
9 such a document?

10 MR. JOHANSEN: Yes.

11 THE CHAIRMAN: And you have it; is that  
12 right?

13 MR. JOHANSEN: I believe Dr. Whillans may  
14 have a copy of it.

15 DR. WHILLANS: I referred to it in my  
16 direct evidence, yes.

17 THE CHAIRMAN: It's not an exhibit. Do  
18 you want it as an exhibit?

19 MR. MATTSON: Yes, Mr. Chairman.

20 THE CHAIRMAN: That should be an exhibit  
21 then.

22 THE REGISTRAR: 623.

23 THE CHAIRMAN: And I don't know whether  
24 you have got it now or whether it will have to be filed  
25 later; is that satisfactory?

1 MR. MATTSON: Yes, Mr. Chairman.

2 DR. CONNELL: I think we have to specify  
3 which BEIR. Is this BEIR 5.

4 MR. MATTSON: 5. Anywhere in the BEIR  
5 actually. I am just going by the evidence given in  
6 direct.

7 DR. WHILLANS: BEIR 5 is 1990.

8 THE CHAIRMAN: It's on the biological  
9 effects of ionizing radiation; is that right?

10 MR. JOHANSEN: Yes.

11 DR. WHILLANS: The correct title is  
12 actually The Health Effects of Exposure to Low Levels  
13 Ionizing Radiation, BEIR 5.

14 ---EXHIBIT NO. 623: The Health Effects of Exposure to  
15 Low Levels Ionizing Radiation, BEIR 5.

16 MR. MATTSON: Q. Thank you.

17 Maybe, Dr. Whillans, you could help me.  
18 Where in that document do you recall seeing reference  
19 to the effects of radioactive emissions on the natural  
20 environment?

21 DR. WHILLANS: A. I'm sorry, I can't  
22 help you with that.

23 I have referred to it in my own evidence,  
24 I am fairly familiar with it but I have been looking at  
25 it primarily from the point of view of human health



1 effects.

2 Q. Mr. Johansen, then, can you say with  
3 certainty then that it was dealt with in that document  
4 as you indicated in your direct evidence?

5 MR. JOHANSEN: A. My statement was not a  
6 reference to the document. It was a reference to the  
7 work of the Committee. And from my general knowledge I  
8 was making the comment that this issue - I guess to  
9 quote - had been studied by a number of international  
10 scientific bodies, and I go on to list a number of  
11 these.

12 I wasn't making the point that it  
13 appeared at a certain place in the document. I  
14 couldn't, without some effort, point to exactly where  
15 it is.

16 Q. Are you aware that it wasn't dealt  
17 with in BEIR? Would you be able to refute that? Do  
18 you know for certain it was or possibly it was not  
19 dealt with in that exhibit?

20 A. I can't say for certain.

21 MR. MATTSON: Maybe I could have an  
22 undertaking, Mr. Chairman, to...

23 THE CHAIRMAN: They have got to produce  
24 the document that you relied on. Maybe you didn't rely  
25 on the document, you relied on your general knowledge.

1                   MR. JOHANSEN: Yes. I was not referring  
2                   to the BEIR 5 document. I was simply referring or  
3                   indicating that these various bodies over the years had  
4                   been considering the effects of radiation, not just on  
5                   humans, but on other biota. That's all I said.

6                   MR. MATTSON: Q. Thank you, Mr.  
7                   Johansen.

8                   Do you know of any publication by BEIR  
9                   that has dealt with the radioactive emissions on the  
10                  natural environment, or Dr. Whillans?

11                  DR. WHILLANS: A. Well, as Dr. Connell  
12                  points out there have been five reports and they are  
13                  all quite lengthy, and it is quite possible that in the  
14                  introduction or some aspect of it there have been  
15                  references to the environment. But that is not their  
16                  primary concern.

17                  The mandate of the committee that  
18                  prepares these is to provide advice on low level  
19                  radiation health effects, and that primarily is in  
20                  humans.

21                  MR. JOHANSEN: A. In making my summary  
22                  statement, I was relying on the ICRP document.

23                  THE CHAIRMAN: This seems to be a de  
24                  minimis problem. I think we can move on to something  
25                  else, don't you think, Mr. Mattson?

1 MR. MATTSON: Yes, thank you, Mr.

2 Chairman. If they had dealt with it, it would have  
3 been helpful to our case to refer to it, discuss it.

4 THE CHAIRMAN: But they don't seem to  
5 know any specific reference.

6 MR. MATTSON: Thank you.

7 Q. A general question to the panel, I am  
8 not sure who would like to deal with this issue. Does  
9 Ontario Hydro ever see and comment on Atomic Energy  
10 Control Board draft documents before they are shown to  
11 the public?

12 MR. KING: A. I can talk to the  
13 documents which are used in the reactor regulation part  
14 of the AECB's business. And since they have come up  
15 with their new regulatory document scheme, which I  
16 believe it was something like 1979 or so that they came  
17 up with their system of consultative documents, to my  
18 knowledge when we see them in Ontario Hydro, we seem  
19 them at the same time that they issue them for public  
20 comment as well. They all go out in one press release.

21 And since that time, and I get to see a  
22 lot of them, a lot of consultative documents, it's  
23 always been on that basis, we got them at the same time  
24 as everybody else.

25 Q. All right. And anybody else on the

1 panel aware of receiving the documents before they are  
2 released to the public?

3 DR. WHILLANS: A. Are you distinguishing  
4 between comments on a document and advice that might be  
5 sought from various people on draft stages of a  
6 document?

7 Q. Well, the draft stages, I certainly  
8 would include, yes.

9 A. Well, I think that probably many  
10 individuals at Ontario Hydro or anywhere else are asked  
11 for advice when the Board is formulating documents, and  
12 at that stage I guess they are not available in a final  
13 form for public review.

14 MR. KING: A. When I was talking about  
15 reactor regulation, I was referring to all copies,  
16 drafts. We don't see anything, which of course causes  
17 problems sometime because there is occasionally  
18 material in there which just because they haven't had  
19 the benefit of some industry review, it has to be  
20 corrected, not that it is opinion, it is fact type  
21 material, it has to be corrected when they come out  
22 with their final document. But that's something that  
23 they are willing to suffer, if you will, in order to  
24 maintain this very conscientious effort on their part,  
25 and certainly on the reactor regulation side, that we

1 see it at the same time as the public sees it.

2 Q. And just to finish this issue very  
3 quickly. Is Ontario Hydro represented on the Atomic  
4 Energy Control Board's Advisory Committee on Radiation  
5 Protection, Dr. Whillans?

6 DR. WHILLANS: A. If you give me a  
7 moment, I have the current status committee here.

8 MR. KING: A. While Dr. Whillans is  
9 looking that up, if your next question is going to be  
10 with respect to the advisory committee on nuclear  
11 safety, no, Ontario Hydro is not recommended on that  
12 committee.

13 Q. Thank you. That was my next  
14 question.

15 DR. WHILLANS: A. Well, I have the March  
16 '91 composition, and I guess I am not sure that it's  
17 still the case, but the chairman is a radiologist from  
18 Vancouver, and there a former director of the health  
19 and safety division now retired from Ontario on the  
20 ACRP.

21 MR. KING: A. It's my understanding as a  
22 matter of AECB policy that Ontario Hydro is not on  
23 these committees.

24 The committees were re-established about  
25 again somewhere around 1980, I forget the exact date.



1 They had previous committees which were much larger but  
2 they disbanded those and came up with these two new  
3 committees, and to my knowledge there has not been any  
4 Ontario Hydro representatives on either of the  
5 committees since that time.

6 Q. Thank you, Mr. King.

7 Dr. Whillans, I believe this is a  
8 question for you. Given that the radionuclides that  
9 Ontario Hydro's nuclear stations emit have vastly  
10 different chemical and biological properties. I take  
11 it you would agree with that.

12 DR. WHILLANS: A. I do.

13 Q. A bewildering family so-called  
14 relative biological effectivenesses for various  
15 species, diseases and life-shortening effects even  
16 within the same radionuclide? Would that be also  
17 true, or do you want me to repeat that.

18 A. No, don't try. [Laughter]

19 For different end points there are  
20 different relative biological effectivenesses, yes, I  
21 agree.

22 Q. And between radionuclides as well,  
23 correct?

24 A. Certainly between radionuclides, yes.

25 Q. Does it make sense then, Dr.

1 Whillans, to continue talking about these substances as  
2 a single toxic called radiation rather than as a class  
3 of toxins that have some broad family resemblance?

4 A. I agree, I prefer the latter  
5 classification. Certainly there are differences, yes.

6 Q. If they are separate, why should  
7 contamination or pollution with one of them be  
8 justified or explained by reference to exposure to  
9 others?

10 A. I am sorry, can you tell me what the  
11 context of that kind of explanation was?

12 Q. Sure. For example, when we are  
13 comparing, for example, tritium, we put it in context  
14 with respect to radiation generally from other  
15 emitters.

16 A. Right.

17 Q. Separate families.

18 A. Well, I agreed with your second  
19 choice which basically talked about a family class,  
20 because they do have the similar characteristic that  
21 there toxicity by and large is because they produce  
22 ionizing radiation which is absorbed in tissue and can  
23 cause health effects.

24 But certainly there are in different kind  
25 of radiations as I described in direct evidence, and

1 even within, for example, beta radiation there are  
2 different energies of betas and they don't all exactly  
3 act in the same way.

4 Moreover, different nuclides are isotopes  
5 of different elements, hydrogen, caesium, and so forth,  
6 and they have different metabolic characteristics.

7 So I don't think at that level we would  
8 try to describe them all as having the same effect.

9 Q. Dr. Whillans, this has been made an  
10 exhibit at the hearing, it's Exhibit No. 525. I am not  
11 sure if you had it, I just had it at the break and I  
12 should have brought it to your attention.

13 A. Can you tell me the title?

14 Q. It's been by Mr. Poch. It's entitled  
15 Nuclear Power Hazard Report.

16 A. I have it but I left it in the  
17 witness room.

18 Q. If you can agree to this, it would  
19 make it easier, if not we can get it. But at page 36  
20 of that exhibit, Irene Cook has compiled some of  
21 Ontario Hydro's data, and she indicates at page 36 that  
22 levels of tritium in air range from 85 to 90 times the  
23 provincial background levels in 1989 and '90.

24 THE CHAIRMAN: Just hold it. Let's find  
25 it. Page 36?

1 MR. MATTSON: Yes, Mr. Chairman.

2 THE CHAIRMAN: What part of page 36?

3 MR. MATTSON: First paragraph.

4 THE CHAIRMAN: That's the first complete  
5 paragraph?

6 MR. MATTSON: Yes. First full sentence  
7 of the first paragraph. Not the first complete  
8 paragraph. The incomplete one at the top.

9 Figure 8 illustrates....

10 THE CHAIRMAN: All right. I have got it.  
11 That's where you are starting.

12 MR. MATTSON: Yes.

13 ...that at the Pickering station  
14 boundary levels of tritium in air range  
15 from 85 to 90 times the provincial  
16 background levels during 1989 to 1990.  
17 At the Bruce site the boundary measures  
18 range from 25 to 32 times the background.  
19 Do you have any reason to dispute those  
20 figures, Dr. Whillans?

21 DR. WHILLANS: A. Well, I don't have our  
22 figures here. I am not sure where she derived the  
23 numbers. But I am sure on average based on our  
24 environmental assessment report, the levels of tritium  
25 are higher at the boundary than they are distant from

1 the station, I would certainly agree with that.

2 Q. And if we look into the next  
3 paragraph as well, it talks about precipitation. The  
4 very last sentence:

5 The annual average levels of tritium  
6 in precipitation at Pickering station  
7 boundary were about 50 times above levels  
8 measured in Oshawa, 20 kilometres to the  
9 east. Tritium levels measured at the  
10 Bruce site boundary are about one-quarter  
11 of the Pickering levels and just under 10  
12 times the local control sample levels.

13 A. I can get out our exhibit if you want  
14 me to check this accurately. But I don't doubt that  
15 tritium levels at the boundary are lower than they  
16 would be at far distances from the station.

17 DR. CONNELL: You said lower?

18 THE CHAIRMAN: You mean higher?

19 DR. WHILLANS: Sorry. They are higher at  
20 the boundary, yes.

21 MR. MATTSON: Q. Dr. Whillans, does it  
22 really makes sense now then to compare the bombardment  
23 of cosmic rays on the population? To put it into  
24 perspective, when we are discussing these levels of  
25 tritium around Pickering, they are eightyfold, and



1       that's tritium, just with respect to tritium, one  
2       poison?

3               THE CHAIRMAN: I am sorry, I don't follow  
4       the question. What is the question?

5               MR. MATTSON: Does it really makes sense,  
6       Mr. Chairman, it was the question that we put these  
7       things -- this eightyfold level of tritium around the  
8       station into perspective by comparing it to cosmic rays  
9       of radiation, the general family, when it's one poison  
10      that we are speaking of here, which is tritium, one of  
11      many under the rubrics of radiation.

12              DR. WHILLANS: Well, you are asking  
13      whether the exposure due to tritium is equivalent to  
14      the exposures due to cosmic radiation, and I said that  
15      the characteristic that was common to all this family  
16      was that they produced ionizing radiation but there  
17      were differences, I think I said that.

18              With respect to tritiated water exposure  
19      we believe that the dose of radiation for the effects  
20      of concern has the same relative effectiveness as that  
21      from cosmic radiation.

22              You referred to the differences amongst  
23      different kinds of radiation, the ICRP and other bodies  
24      recommend quality factors which correct for the  
25      relative biological effectiveness. The quality factor

1       for tritium is one.

2                   Some of the studies that we referred to  
3       with Ms. McClenaghan, at Chalk River were designed to  
4       see if that was indeed true.

5                   MR. MATTSON: Q. And the Chalk River  
6       studies found that 1.2 as opposed to 1?

7       [12:15 p.m.]

8                   DR. WHILLANS: A. Well, there have been  
9       a number of studies.

10                   I think you presented a study of causes  
11       of death other than cancer. There is the main study,  
12       which is the biological effectiveness, the induction of  
13       myeloid leukemia, and in '82 or '83 there was another  
14       study, similar series, looking at another form of  
15       cancer in animals.

16                   All of these studies have found that  
17       there is no difference between the relative biological  
18       effectiveness and the value 1.

19                   So I guess I am saying in an individual  
20       study it may have been 1.2, but the range certainly  
21       covered 1.

22                   Q. Thank you.

23                   Mr. Chairman, I am moving to a new  
24       section and it is an exhibit that hasn't been given a  
25       number. It is entitled Materials on Seismic Risk to

1 Nuclear Plants.

2 THE CHAIRMAN: Have we got that?

3 MR. MATTSON: Yes, I believe --

4 MS. PATTERSON: Tab I.

5 THE REGISTRAR: Tab I.

6 MR. MATTSON: There is only one other  
7 exhibit package, Mr. Chairman, that I will be using in  
8 my cross-examination, and that must be your last tab.

9 THE CHAIRMAN: What number should that  
10 be?

11 THE REGISTRAR: 624.

12 THE CHAIRMAN: 624?

13 ---EXHIBIT NO. 624: Energy Probe's exhibit, entitled  
14 Materials on Seismic Risk to Nuclear  
Plants.

15 THE CHAIRMAN: Thank you.

16 MR. MATTSON: Q. Mr. King, I understand  
17 that for the most part these questions are with respect  
18 to safety so I will direct them at you.

19 Mr. King, perhaps it is trite and it is  
20 obvious to even mention, but can we agree in principle  
21 that if a nuclear generation station is shaken hard  
22 enough both its structure and much of its equipment  
23 will fail?

24 MR. KING: A. Anything will fail if it  
25 is shaken hard enough.

1 Q. And distinguishing between the  
2 structure and its equipment, both those two things  
3 would fail?

4 A. As a general statement, if equipment  
5 or systems or structures are shaken hard enough, and  
6 that is the important assumption there--

7 Q. Right.

8 A. --that some type of failure can  
9 occur.

10 Q. And that in such a case, Mr. King,  
11 the resulting simultaneous failures, what I believe  
12 Ontario Hydro calls the common mode event or accident,  
13 could easily constitute an event or accident that is  
14 beyond design basis, and that has not been analyzed;  
15 correct?

16 A. Well, by definition beyond the design  
17 basis...

18 Well, let me explain what design basis  
19 means. In the regulatory environment there are certain  
20 types of accidents which have to be analyzed and shown  
21 in the safety report to meet certain limits.

22 The regulator has rules to define  
23 accidents and accident classes which they believe are  
24 sufficiently likely or there is a threshold of  
25 likeliness of frequency at which they are taking as a

1 regulator, taking the responsibility that they have  
2 been given by the government to say, well, if it is so  
3 very, very unlikely I don't think you need to design  
4 and meet defined regulatory dose limits for those types  
5 of accidents. The ones that are within the design  
6 basis spectrum, you do.

7 So whether it is seismic or in other  
8 areas, one can always postulate some very, very low  
9 probability accidents which are outside the design  
10 basis.

11 Also, being outside the design basis does  
12 not mean automatically that the dose limits would be  
13 exceeded. There are many nondesign basis accidents  
14 which would not exceed the design basis, exceed the  
15 regulatory limits.

16 Q. And, Mr. King, those kinds of  
17 accidents that if the nuclear generating station was  
18 shaken hard enough beyond the design basis, those type  
19 of accidents and others at least in principle caused by  
20 a major seismic event are not analyzed in the DPSE, the  
21 Darlington Probabilistic Safety Evaluation, are they?

22 A. There are probably some nondesign  
23 basis accidents which are analyzed in the DPSE, as I  
24 prefer to call it, the Darlington Probabilistic Safety  
25 Evaluation.



1                   There is a class of accidents in that  
2                   study which we looked at the frequency, we identified  
3                   the various sequences, the combinations of initiating  
4                   events and system failures that could lead to this  
5                   class of events, and we summed all the frequencies of  
6                   getting into this class of accident events, but we did  
7                   not continue with the off-site consequence analysis for  
8                   those events.

9                   Also, that is for events which were  
10                  within the scope of the DPSE. There were also some  
11                  events which were not within the scope of the DPSE.

12                  Q. Certainly external events such as a  
13                  seismic event wasn't included in the DPSE?

14                  A. Right from the beginning it was not  
15                  within the scope of the DPSE.

16                  Q. Thank you. And is it also true, Mr.  
17                  King, that it was not included in the more  
18                  deterministic safety analysis that is done under C6?

19                  A. No, that is not true.

20                  Q. And where was it included?

21                  A. Well, the Darlington safety report.  
22                  I must admit I forget what exhibit that is, but I am  
23                  sure somebody will tell me. There is an appendix which  
24                  analyzes the design basis seismic ground motion, what  
25                  is called the DBE, the design basis earthquake.

1                   That is 9.7.58, is the interrogatory in  
2                   which we responded with the full Darlington safety  
3                   report.

4                   Q.   Thank you.   But not beyond design  
5                   basis; correct?

6                   THE CHAIRMAN:   9.7.58 may or may not have  
7                   been given a number, I'm not sure.   The DBE has been  
8                   referred to.

9                   MR. KING:   I referred to it in my direct  
10                  evidence, so if --

11                  MR. B. CAMPBELL:   I think it has 520.1.

12                  THE CHAIRMAN:   Thank you.

13                  MR. MATTSON:   Q.   But, Mr. King, it  
14                  didn't look at that seismic event beyond design basis;  
15                  correct?

16                  MR. KING:   A.   No.   When I explained in  
17                  my initial comments on what the design basis was what  
18                  is the safety report, what is reported in the safety  
19                  report are design basis accidents.

20                  So we have defined an earthquake of  
21                  sufficient energy, of sufficient, in your terms, shake  
22                  of the reactor building, that we and the regulator  
23                  thought that it was sufficiently severe that we  
24                  terminated it there and we reported what would happen  
25                  in the plant with that size of shake, in your words.

1 Q. Thank you. Now, still speaking  
2 generally, Mr. King, do I understand correctly that the  
3 damage to be expected from an earthquake is generally  
4 considered to be a function of two major  
5 characteristics of ground motion: one magnitude, and  
6 the other the frequency of vacillation?

7 A. Determining what the design basis  
8 earthquake for a particular site is a very complex  
9 procedure, but once you have determined that it is  
10 expressed in something we call a design basis seismic  
11 ground motion.

12 And that expression has characteristics  
13 of acceleration, of what is called the free field - it  
14 is the rock nearby the station - and it also has an  
15 expression of the frequency of the excitation, and both  
16 the acceleration and the frequency of the acceleration  
17 are important parameters.

18 Q. All right. Mr. King, just before I  
19 go to some of the documents, just for clearing this  
20 issue up, the magnitude of the predicted seismic ground  
21 motion is generally expressed in acceleration; correct?

22 A. Well, magnitude is the measure of the  
23 release of energy at the epicentre of the earthquake,  
24 which could be a distant location from the site.

25 Q. All right.

1                   A. Then you have to look at that energy  
2     release, and there are methods to then look at the  
3     attenuation of that energy through the rock from that  
4     epicentre to the site that you are interested in, and  
5     then you express it as an acceleration, and some other  
6     parameters identifying the type of shake it is at your  
7     site location.

8                   Q. All right. And in the documents that  
9     will be seen as a percent of G, acceleration of  
10    gravity, or in centimetres per second squared; correct?

11                  A. Acceleration is more of a  
12    conversational or rough estimate of the size, the  
13    importance of the shake.

14                  When it gets down to being used in a  
15    calculation, in a design calculation for seismic design  
16    engineers or civil engineers, then they do not use  
17    acceleration; they need much more information defining  
18    what the earthquake is.

19                  Q. And as a split beside the magnitude,  
20    the frequency of oscillation that is expressed in  
21    Hertz; correct?

22                  A. That's right. The frequency is  
23    important in that just with any excitation of any  
24    mechanical device, the frequency of the excitation, you  
25    have to look at the natural frequency of the thing that

1       you are trying to excite, and if it is close to a  
2       residence frequency, then they will excite in tune with  
3       the forcing function.

4                   Q.   Thank you.   And you would also agree,  
5       Mr. King, that different parts of a nuclear generating  
6       station are susceptible to damage from different  
7       frequencies of seismic ground motion; correct?

8                   A.   Yes, but the important thing is the  
9       natural frequency of the structure, because you cannot  
10      excite equipment which is attached to the structure in  
11      upper floors unless you excite that structure to a  
12      certain degree, and natural frequencies of structures  
13      tend to be very low.

14                  Q.   So in general, the structures, walls,  
15      and roofs would be vulnerable to lower frequencies  
16      while the equipment, pumps, valves and pipes, fueling  
17      machines would--

18                  A.   Well, I think it is more complex.

19                  Q.   Just let me finish my question:  
20      --would generally be more vulnerable to higher  
21      frequencies?

22                  A.   That is generally correct, but the  
23      process to determine what those frequencies are, the  
24      frequencies that you are talking about are not the  
25      ground motion frequencies that you were talking about



1 earlier. They are two different frequencies.

2 So what happens is that you have to model  
3 your whole structure, the various floors, the  
4 structure, all the walls, and then you input the rock  
5 forcing function which comes from the earthquake, and  
6 then you have forcing functions then for every location  
7 in your structure, and then you look to see where you  
8 have your hanger for your pipe hanger or where your  
9 pump is located on a floor, and there you have a  
10 completely different forcing function for that  
11 component.

12 And that is a function of the type of  
13 structure you have and the type of excitation at the  
14 bottom of that structure.

15 Q. Before I go to my next question, have  
16 you done that for Pickering, that type of analysis for  
17 Pickering generating station?

18 A. Which station?

19 Q. Pickering, Pickering "A"?

20 A. Pickering "A"? Pickering "A" in the  
21 days it was designed, back in the late 60s, the methods  
22 used for seismic qualification were different than what  
23 they are today - for Darlington, for example.

24 In those days they used more static  
25 methods of qualification. They didn't model the whole

1 reactor structure and do this dynamic modelling to get  
2 forcing functions at the various levels. It was more a  
3 static method following the rules of the National  
4 Building Code of Canada, applied primarily to  
5 structures.

6 What I mean by static method, in the  
7 design of the structures they have loads which they get  
8 from tables which are representative of earthquake  
9 loads on structures.

10 Q. To get back to the analysis, have you  
11 done that since the original design?

12 A. No, we have not gone back to  
13 Pickering "A" and done a dynamic analysis of all  
14 aspects of Pickering "A". On some backfits to  
15 Pickering "A" there has been some degree of seismic  
16 qualification to current standards.

17 Q. Mr. King, then, the most damaging  
18 frequencies for different pieces of equipment would  
19 naturally be different then depending on their own  
20 natural or resident frequencies; is that fair?

21 A. As I said, the degree of excitation  
22 of a piece of equipment, or of anything, is a function  
23 of its natural frequency and the frequency of the  
24 excitation.

25 Q. Now, if I could have everyone turn to

1 page 26 of the exhibit, this is the beginning of an  
2 interrogatory response. The interrogatory is from  
3 Energy Probe, No. 9.2.17.

4 THE REGISTRAR: That will be .110.

5 ---EXHIBIT NO. 520.110: Interrogatory No. 9.2.17.

6 MR. MATTSON: Q. And the interrogatory  
7 asks: Please provide all reports on structural  
8 geology, seismicity and earthquake location, including  
9 all maps and other attachments. Include all reports by  
10 Gail Atkinson, Earth and Ocean, et cetera.

11 In response you provided five reports  
12 which are attached, and I note, Mr. King, if you look  
13 down the number of reports, the fourth report and the  
14 fifth report, the fifth report is Seismic Hazard at  
15 Ontario Hydro Dam and Plant Sites, by G. Atkinson, and  
16 the fourth report on the list was the Updated Seismic  
17 Hazard Estimates at Ontario, by G.M. Atkinson; correct?

18 MR. KING: A. I see that.

19 Q. And the excerpts from those two  
20 reports are provided. The fifth one is between pages  
21 27 and 78, and the Update is provided -- excerpts are  
22 provided in the exhibit between page 79 and 102. And I  
23 will be referring to both of those.

24 THE CHAIRMAN: Perhaps we should give  
25 them exhibit numbers.

1 MR. MATTSON: Fine, Mr. Chairman. Then,  
2 the Seismic Hazard at Ontario Hydro Dam and Plant  
3 Sites, 1987, Exhibit...?

4 THE CHAIRMAN: Next number?

5 THE REGISTRAR: I am just trying to find  
6 the page.

7 THE CHAIRMAN: Page 27.

8 THE REGISTRAR: 27. That will be 625.

9 ---EXHIBIT NO. 625: Seismic Hazard at Ontario Hydro  
10 Dam and Plant Sites, by G.M. Atkinson.

11 THE CHAIRMAN: And that goes through to  
12 what page?

13 MR. MATTSON: That goes through to page  
14 75.

15 THE CHAIRMAN: 75?

16 MR. MATTSON: Yes.

17 THE CHAIRMAN: All right.

18 MR. MATTSON: And then at page 76,  
19 entitled, Updated Seismic Hazard Estimates at Ontario  
20 Hydro Sites, June, 1990, prepared by Gail Atkinson.

21 THE CHAIRMAN: That will be next number,  
22 please.

23 THE REGISTRAR: 626.

24 ---EXHIBIT NO. 626: Updated Seismic Hazard Estimates  
25 at Ontario Hydro Sites, June, 1990,  
prepared by G.M. Atkinson.

1  
2 MR. MATTSON: And that goes through to  
3 page 102.

4 THE CHAIRMAN: All right.

5 MR. MATTSON: Q. If you could turn to  
6 page 24 of the exhibit, which -- before I get to those  
7 two studies I would like to first reference you to page  
8 24 and 25 of the exhibit, and at page 24 it is an  
9 interrogatory from Energy Probe, No. 9.2.16.

10 THE REGISTRAR: It becomes .111.

11 ---EXHIBIT NO. 520.111: Interrogatory No. 9.2.16.

12 MR. MATTSON: Q. And on page 25 it is an  
13 interrogatory response, 9.2.16A.

14 THE REGISTRAR: That will be .112.

15 ---EXHIBIT NO. 520.112: Interrogatory No. 9.2.16A.

16 MR. MATTSON: And that was a follow-up on  
17 the first interrogatory, Mr. Chairman.

18 Q. Mr. King, if you look at page 24.111  
19 it asks: Please provide Hydro's best estimate as to  
20 the effect in terms of cost, output of each nuclear  
21 unit, power system reliability, reactor life  
22 shortening, and any other affected aspect of Hydro's  
23 operation if all nuclear plants had to be raised to a  
24 seismic qualification of 15 per cent G design  
25 acceleration, and provide the same analysis of impacts



1 if the seismic qualification had to be raised to 20 per  
2 cent G design acceleration.

3 You note in your response that the design  
4 basis earthquake for Pickering and Bruce and Darlington  
5 sites were set at 5 per cent G and 8 per cent G  
6 respectively, based on seismic studies.

7 Is that your understanding as well, Mr.  
8 King?

9 MR. KING: A. That's correct, with the  
10 proviso that just the simple G definition of the  
11 earthquake size is just used for convenience. It is  
12 really expressed in a much more complicated function.

13 Q. And, Mr. King, if you turn to page 25  
14 of the exhibit, Interrogatory .112, you note we  
15 followed up that with a question, which reads:

16 We asked for the costs of 20 per cent  
17 G designed acceleration. Please provide  
18 an answer to the question. Perry nuclear  
19 generating station in Ohio on the south  
20 shore of Lake Erie and located on very  
21 similar geology to that of several of  
22 Hydro's present and proposed stations has  
23 experienced 18 per cent G in a recent  
24 seismic event.

25 And your response:

1                   This question reflects a lack of  
2                   understanding of earthquake engineering.  
3                   While a peak ground acceleration of 18  
4                   per cent G was measured on rock at the  
5                   Perry site during a reading of 5 on the  
6                   earthquake scale on the 31st, '86, this  
7                   acceleration occurred at a frequency of a  
8                   vibration of 25 Hertz, which was too high  
9                   to be felt by the nuclear structures on  
10                  site.

11       You note that nuclear structures have natural  
12       frequencies of vibration in the order of 2 to 10 cycles  
13       per second.

14                  And again at the bottom of that  
15       paragraph, you say:

16                  Such high frequency seismic motions  
17                  have no impact on nuclear structures.

18       And, Mr. King, would that be true also of nuclear  
19       equipment?

20                  A. Well, I looked at this answer last  
21       night - we got this material yesterday at noon - and I  
22       think this answer is correct.

23                  It is my understanding, and my  
24       understanding has been based on my experience dealing  
25       with seismic engineers and seismologists over the last

1 15 years or so, but not being one myself, is that if  
2 the building is not excited, if it doesn't start  
3 shaking based on the forcing function of the  
4 earthquake, then you will not transmit those high  
5 frequency vibrations - if the earthquake is a high  
6 frequency - you will not transmit those to equipment  
7 which is supported within that structure.

8 Q. So would your position be, then, that  
9 the building would always fail before the equipment  
10 would?

11 A. No, sorry. I understood your  
12 question to be: Would the equipment be at risk  
13 because -- we have said in this response that the  
14 building, structure isn't at risk, but would the  
15 equipment be at risk given that the equipment, as you  
16 have suggested earlier, may have a natural frequency  
17 higher than the equipment, okay?

18 [12:40 p.m.]

19 My answer is that that's not, in my  
20 understanding of how these things work, quite so simple  
21 as that. The building has to get excited first before  
22 it can transmit the energy of excitation to the  
23 equipment within that building. And if the building  
24 doesn't get excited to do that, then it will not  
25 happen.

1                   So if there are some very low level high  
2 frequency vibrations transmitted to upper floors where  
3 the equipment would be, it just do not have the energy  
4 content to do anything to that equipment.

5                   Q. Mr. King, the 18 per cent G that was  
6 measured at the Perry site, are you familiar with that?  
7 Are you aware of that?

8                   A. Yes, but that is a ground motion.  
9 That's not within the building.

10                  Q. But that's beyond design basis for  
11 the Pickering, Bruce --

12                  A. No. As I say, you just cannot look  
13 at acceleration by itself in deciding the design basis  
14 earthquake. The design basis earthquake is expressed -  
15 I am not sure you have seen them - but it's a very  
16 complex graph plotting acceleration, frequency,  
17 displacement and velocity all on one graph, and that's  
18 what defines design basis earthquake. It is not an  
19 acceleration.

20                  Q. I understand that. But let's go  
21 back. Can you confirm that the interrogatory response  
22 at any rate contains multiple references specifically  
23 to nuclear structures and no references to nuclear  
24 equipment? Would you agree with that?

25                  A. Our response right here?

1 Q. Yes.

2 A. Well, I would have to reread it right  
3 now. I read it last not but not with that question in  
4 mind.

5 It appears to just talk about structures,  
6 yes. And I think it is a valid discussion for the  
7 reasons I have just given.

8 Q. Please turn to page 28 of the  
9 exhibit.

10 First of all, Mr. King, at page 27 is the  
11 Atkinson Report, the Seismic Hazard at Ontario Hydro  
12 Dam and Plant sites. Are you familiar with this  
13 document?

14 A. I have read the material you have  
15 provided, and I may well have got a copy when it was  
16 produced. But my familiarity with it is based on my  
17 reading it last night, or the excerpts that you  
18 provided last night.

19 Q. If you turn to page 28 of the  
20 exhibit, and I am looking three paragraphs down, this  
21 is the cover letter, a Mr. H.S. Irvin, Director?

22 A. To Mr. Irvin.

23 Q. To Mr. Irvin, correct, from Atkinson.

24 A. No.

25 Q. Sorry. From E.M. Taylor, Manager,



1 Geotechnical and Hydraulic Engineer.

2 THE CHAIRMAN: It's an internal Hydro  
3 memorandum; is that correct?

4 MR. MATTSON: That's correct, Mr.  
5 Chairman, it was provided with the...

6 THE CHAIRMAN: Perhaps it should be given  
7 an exhibit number.

8 THE REGISTRAR: 627.

9 THE CHAIRMAN: How far does it run, Mr.  
10 Mattson?

11 MR. MATTSON: It is just the two pages,  
12 Mr. Chairman, that was included in the earlier exhibit.

13 THE CHAIRMAN: That's right, it's part of  
14 625.

15 MR. MATTSON: That's correct.

16 THE CHAIRMAN: It shouldn't be given an  
17 exhibit number, I apologize.

18 THE REGISTRAR: 627 is cancelled.

19 THE CHAIRMAN: Thank you.

20 MR. MATTSON: Q. Mr. King, if you look  
21 at the third paragraph down, I am reading: In essence  
22 her results --

23 THE CHAIRMAN: Just to exonerate me in  
24 some way, it's not part of the Atkinson report; is that  
25 right?

1 MR. MATTSON: No, Mr. Chairman. It came  
2 with the report as given to us by Ontario Hydro, it was  
3 the cover letter to the report.

4 Q. It reads:

5 In essence, her results indicated that  
6 for structures founded on rock in eastern  
7 Canada, the amplitude of seismic ground  
8 motion was generally too low and of too  
9 short a duration to cause significant  
10 damage. The peak amplitudes are  
11 generally associated with frequencies  
12 that are too high to impact adversely on  
13 such structures. Equipment response at  
14 high frequency needs some further  
15 examination, although preliminary  
16 assessments in U.S. indicated that to be  
17 of limited impact as well.

18 Mr. King, are you aware of any subsequent  
19 examination done by Ontario Hydro with respect to  
20 equipment response at high frequencies?

21 MR. KING: A. With respect to this  
22 particular memo I am not aware.

23 I am just aware that the whole structures  
24 are modelled in great detail with finite element codes,  
25 and the excitations that are seen by equipment are

1 input into the design of that equipment and any support  
2 supports that may be associated with that equipment.

3 Q. This report, Mr. King, if we turn to  
4 page -- we don't need to turn to a page if you are  
5 aware of the report, but the Atkinson Hydro report also  
6 does not deal with Pickering, correct? It just deals  
7 with Bruce and Darlington nuclear stations?

8 A. From the title it looks like it's the  
9 Ontario Hydro dam and plant sites.

10 Q. Maybe we can turn to the pages.

11 Page 73 of the exhibit. Top of the page,  
12 Conclusion, Summary of Results, the consultant states:

13 Seismic hazard and its uncertainty has  
14 been evaluated at nine Ontario Hydro dam  
15 sites and two nuclear sites, Darlington  
16 and Bruce.

17 Are you aware of anything that would  
18 indicate that it included Pickering?

19 A. No. But it's my understanding that  
20 what Ms. Atkinson and her co-author, I guess, are  
21 looking at is area effects, not very, very local  
22 effects, and I would think then that the Bruce and  
23 Darlington sites, if you just look at the sort of  
24 equations that she is dealing with, that is really one  
25 and the same thing, but that's just my impression. I

1 would have to look at the full report again to see if  
2 there is any other reason why they are not looking at  
3 Pickering.

4 Q. So, again, this report deals with the  
5 structure, the seismic hazard to the structures, not  
6 then to the equipment at the specific plants; correct?

7 A. No. I think this report is just to  
8 do with estimating the excitation of the ground at  
9 various places. It has nothing to do with structures  
10 or equipment.

11 Q. Thank you.

12 A. That is Ms. Atkinson's expertise, she  
13 is a seismologist and that's her expertise.

14 Q. And, Mr. King, is it Hydro's position  
15 that Bruce and Darlington are both more stringently  
16 seismically qualified, then Pickering, i.e., that they  
17 could in general be confidently predicted to withstand  
18 greater seismic ground motion?

19 A. Well, I believe the Pickering and  
20 Bruce sites are designed to the same design basis  
21 earthquake. Again if we are just using the loose  
22 terminology of acceleration, I believe it's .05 G in  
23 each case and Darlington it's .08 G.

24 There was a second part of your question,  
25 I have forgotten.

1 Q. Sure. Could it be in general, be  
2 confidently predicted -- that is could Darlington and  
3 Bruce be confidently predicted to withstand greater  
4 seismic ground motion than Pickering?

5 A. First of all, I think all of the  
6 stations from my discussions with our experts in this  
7 area, all have potential to handle much larger  
8 earthquakes than the design basis earthquakes for the  
9 sites. Given that they can all handle much larger,  
10 whether Bruce can handle more than Darlington, or  
11 Darlington more than Pickering, I am not aware of any  
12 studies showing that. I guess one would think that  
13 Darlington would probably be able to handle larger than  
14 Pickering, but the I am not aware of any studies that  
15 we have done with that in mind to show that.

16 Q. Now, I am going to turn to the actual  
17 studies done by Ms. Atkinson. Mr. King, is it fair to  
18 say that the earthquake record in Southern Ontario is  
19 brief and relatively empty, i.e., few quakes?

20 A. Well, earthquakes go back a long  
21 time. I think what you are referring to, it's our  
22 presence here which has been short, and hence the  
23 recorded period with instruments is only a matter of  
24 tens of years. The recorded period with respect to  
25 observations from looking at old newspapers and



1 missionary records, et cetera, that only extends a few  
2 hundred years at most.

3 Q. And would it be wrong to conclude,  
4 Mr. King, that a large earthquake is impossible,  
5 incredible or even very unlikely; correct?

6 A. I believe a seismologist would say  
7 that it's not impossible. I think they would not agree  
8 with you suggesting that it was not -- I think your  
9 wording suggested it was likely, or maybe you used a  
10 double negative, but I don't think they would agree  
11 with you, with what you said.

12 Q. Maybe we can look at your expert and  
13 what she determined. If you turn to page 26 of the  
14 exhibit where the reports begins, and then it's page 41  
15 of the exhibit, specific reference. The first full  
16 paragraph, and I am reading from the third sentence  
17 down.

18 A. One second please. Okay.

19 Q. There is widespread belief often  
20 reflected in seismic zoning maps that  
21 lower occurrence rates are associated  
22 with lower Mx values.

23 And, Mr. King, am I correct that Mx means  
24 maximum credible earthquake?

25 A. I am not sure, actually.

1 Is it defined here somewhere?

2 Q. Page 35 is the definitions. Maximum  
3 magnitude, Mx.

4 THE CHAIRMAN: Where do you see that?

5 MR. MATTSON: End of the first paragraph.

6 MR. KING: I am not sure, I have to look  
7 at this a little closer, I am not sure they are  
8 referring to the maximum possible earthquake or maximum  
9 earthquake at which the Gutenberg-Richter relationship  
10 is valid for.

11 MR. MATTSON: Mr. Chairman, it's close to  
12 one, maybe I could go back and find the exact reference  
13 to that before I go through it. It's very difficult to  
14 get through this document, as I am sure you are  
15 painfully aware.

16 MR. KING: It was a long night.

17 THE CHAIRMAN: Your predecessor who has  
18 now left, thought she would be finished about now.  
19 What do you say?

20 MR. MATTSON: I should definitely be  
21 finished by the noontime break. I was a lot longer --

22 THE CHAIRMAN: This is the noontime  
23 break.

24 MR. MATTSON: Afternoon break, Mr.  
25 Chairman. I was a little longer this morning than I

1 had intended.

2 THE CHAIRMAN: Thank you. We will a  
3 adjourn until 2:30.

4 THE REGISTRAR: Please come to order.  
5 This hearing will adjourn until 2:30.

6 ---Recess at 12:55 p.m.

7 ---On resuming at 2:35 p.m.

8 THE REGISTRAR: Please come to order.  
9 This hearing is again in session. Be seated, please.

10 THE CHAIRMAN: For the purpose of record  
11 I have been asked to advise the hearing that status has  
12 been grant to one additional party; that is, the  
13 Windsor Utilities Commission. It has been granted  
14 part-time status. And AECL has requested that its  
15 part-time status be elevated to full-time status, and  
16 that request has been granted.

17 MR. MATTSON: Thank you, Mr. Chairman.

18 Q. We ended just before lunch at page  
19 41, the Atkinson study, and there was a difficulty with  
20 respect to the definition of Mx, and I would ask you to  
21 look to page 37 of the exhibit at the bottom of the  
22 page, entitled Maximum Magnitudes, Mr. King? Do you  
23 see that?

24 MR. KING: A. Yes, I see that.

25 Q. And the paragraph reads:

1                   The magnitude recurrence relations are  
2                   truncated at an upper bound  $M_x$ , above  
3                   which events are not considered possible  
4                   within that zone.

5       And then states:  $M_x$  is... And the next page is page  
6       41 because of the number of graphs:

7                    $M_x$  is supposed to be a physical  
8                   constraint on the maximum amount of  
9                   seismic energy that can be released by a  
10                  feature.

11       Do you see that?

12                  A. Yes, I have had an opportunity to  
13       review this over lunch, and that is my understanding of  
14       what  $M_x$  is.

15                  Q. Then back to the question, Mr. King.  
16       I will review it so that we are clear here. I was  
17       asking you about the earthquake record in Southern  
18       Ontario and pointing out that it was brief and  
19       relatively empty, but I suggested that it was wrong to  
20       conclude from that that a large quake is impossible,  
21       incredible or even very unlikely.

22                  And reference to the Atkinson report, the  
23       last five lines from that first paragraph that I was  
24       reading, states:

25                  The lesson is that while low

1 occurrence rates for small to moderate  
2 events --

3 A. Excuse me. Where are you reading?

4 Q. Page 41. The lesson is that...

5 A. I have got it, yes.

6 Q. ...while low occurrence rates for  
7 small to moderate events imply that large  
8 magnitude events will have a very low  
9 recurrence rate, they do not prove that  
10 large events are impossible. The  
11 seismicity rates for most parts of Canada  
12 are sufficiently low that the maximum  
13 magnitude will not have occurred during  
14 the historic record. Historic seismicity  
15 thus gives no information on maximum  
16 magnitude.

17 Would you agree with that?

18 A. That is my understanding, and I think  
19 that is consistent with my answer to your question.  
20 This does not suggest that they are likely; this just  
21 refers to whether they are possible or not.

22 Q. That's right. And the support for  
23 that proposition, if we just look above that sentence,  
24 do you see the reference to the excellent example of a  
25 large earthquake sequence near the Nahanni River in the



1 Northwest Territories?

2 A. I see that reference.

3 Q. And do you see where it has the  
4 maximum possible value 6 -- had been considered to be  
5 6? That was maximum possible value?

6 A. Yes.

7 Q. And then it goes on to show that in  
8 December, 1985 an earthquake of magnitude near 7  
9 occurred in the area. Do you see that?

10 A. I see that. But I think it is  
11 characteristic of places where they had no historical  
12 record at all because no one was there during  
13 historical period.

14 Q. Right. And would you confirm that  
15 the difference between a magnitude 6 and a magnitude 7  
16 is 10 times, an order of 10 times the amount?

17 A. In the energy released at the  
18 epicentre.

19 Q. All right. Thank you. Now, if you  
20 turn to page 12 of the exhibit.

21 DR. CONNELL: I would just like to ask a  
22 question before we proceed.

23 Perhaps I could frame it this way. We  
24 have one seismic event and an inference drawn from it.  
25 Do you think, Mr. King, that you can generalize from

1       that one event; that is, do you think that you could  
2       then go to virtually all other areas of relatively  
3       infrequent seismic activity and speculate with some  
4       justification that a much higher energy event is  
5       possible?

6                   MR. KING: Well, the whole question of  
7       coming up with magnitude recurrence equations or  $M_x$  is  
8       very area-specific, and I think I was -- it is also  
9       dependent on how you came up with  $M_x$  before.

10                   In this particular sentence here it says  
11       the area had previously been considered to have an  $M_x$ .  
12       Now, what I don't know is how they previously had  
13       determined. That is why I referred to the historical  
14       record.

15                   If they had determined that from the  
16       historical record, in that part of Canada there is very  
17       little historical record because how they determine  
18       magnitudes by the historical record is just looking to  
19       see how were buildings affected and looking at church  
20       records and whatever, and translating that to a  
21       magnitude, and if nobody is there they don't have those  
22       records.

23                   So I just don't know how they determined  
24       that. I assumed that they have determined it from the  
25       historical record, and in that part of Canada the

1 historical record would have a lot of uncertainty about  
2 it.

3 So it doesn't surprise me that they have  
4 changed the Mx value.

5 DR. CONNELL: Since when have  
6 seismologists been able to determine the epicentre from  
7 remote observations? Is that just within the last 20,  
8 30 years, or does it go back?

9 MR. KING: Well, it depends again on the  
10 goodness of your historical record. You have to  
11 triangulate to get the epicentre, so you have to  
12 historical records from various points and -- or what  
13 you do is you get -- there are kind of isobars of  
14 damage, and then if there are equal isobars all around  
15 there it must have been perhaps in the middle where the  
16 epicentre was.

17 But it is kind of a black art  
18 interpreting the historical record to come up with an  
19 early seismic history of Canada, but several people do  
20 that and that is all there is available.

21 DR. CONNELL: But can you say when the  
22 science was sufficiently developed that epicentres of  
23 major quakes could be located with reasonable  
24 confidence?

25 MR. KING: Okay. There is the historical

1 period and then there is the instrumented period.

2 DR. CONNELL: And when is this?

3 MR. KING: The instrumented periods, I  
4 believe it started something like in the 30s. But I  
5 could be wrong there.

6 DR. CONNELL: And presumably there has  
7 been an improvement in precision?

8 MR. KING: And with the period of  
9 instrumentation it is also a function of how many  
10 instruments you have and where they are located.  
11 And I am sure that there wouldn't be any instruments up  
12 in the Northwest Territories then and I would assume  
13 probably not now.

14 They are generally around centres of  
15 population, and, in fact, Hydro is quite involved in  
16 helping pay for instruments throughout the southern  
17 part of Ontario.

18 DR. CONNELL: Well, the bottom line on  
19 this one, I take it, is you are not prepared to concede  
20 that Southern Ontario is likely to be in the same  
21 position as the Nahanni Valley?

22 MR. KING: Correct. Because the Mx is 6  
23 or 6.5, or whatever it is, up in the Nahanni River it  
24 means nothing with respect to Southern Ontario, in my  
25 understanding of it.

1 But I think the Mx values are not  
2 wide-ranging, I don't think. They don't have Mx values  
3 of 5 or something. I think they are all -- it depends  
4 on the rock, type of rock primarily, but there are  
5 other factors as well.

6 And I haven't seen in this report -  
7 perhaps it is here - where they have listed Mxs for  
8 many different areas. But perhaps it is here. I just  
9 haven't noted it.

10 DR. CONNELL: But there is at least some  
11 risk of a current estimate of Mx being inappropriately  
12 low, virtually any conceivable site; would that be  
13 fair?

14 MR. KING: Well, as I think it suggests  
15 in this paper that if further work was to be done it is  
16 likely that the Mx values that are used right now would  
17 be reduced and not -- and we have marked those  
18 sections.

19 MR. MATTSON: We will probably be getting  
20 to those.

21 MR. KING: That is what Ms. Atkinson's  
22 belief is: if we spent more work refining the Mx  
23 values they would be decreased, not increased.

24 DR. CONNELL: Thank you.

25 MR. MATTSON: Q. Now, Mr. King, if you



1 turn to page 12 of the exhibit it is excerpts from  
2 "MAGNEC", Multi-Agency Group for Neotectonics in  
3 Eastern Canada?

4 MR. KING: A. I have that.

5 Q. And those excerpts run from page 12  
6 to 15? And then following them are the MAGNEC minutes  
7 of meeting, February 21st, 1990. Do you see those?  
8 They run from page 16 to 23 of the exhibit.

9 A. I believe they are just excerpts from  
10 the minutes, not the complete minutes.

11 Q. That's correct. That's correct. And  
12 I noticed on page 16 of the exhibit that the front  
13 page, the minutes of meeting, that Ontario Hydro is a  
14 member of MAGNEC; correct?

15 A. I'm not sure we are a member. We  
16 attended the meeting.

17 Q. All right. Now, if you would turn --

18 THE CHAIRMAN: Do you want an exhibit  
19 number for this series of pages?

20 MR. MATTSON: Yes, Mr. Chairman. I will  
21 have.

22 THE CHAIRMAN: 12 to 23?

23 MR. MATTSON: 12 to 23.

24 THE CHAIRMAN: Number?

25 THE REGISTRAR: 627.

1       ---EXHIBIT NO. 627: Excerpts from MAGNEC meeting,  
2                               February 12, 1990.

3                       MR. MATTSON: Q. Now, Mr. King, going to  
4       the annual report, 1989 annual report which is dated at  
5       the bottom July, 1990 - so it is dated on page 12 - and  
6       turning over to page 13, page 13 is entitled  
7       Implications of the 1988 Saguenay Earthquake for  
8       Seismic Hazard Zoning of Southeastern Canada.

9                       Do you see that?

10                      MR. KING: A. I see that.

11                      Q. By Adams, J. and Basham, P.W.?

12                      A. Yes.

13                      Q. Geological Survey of Canada? And I  
14       would ask you -- I will try and get through this as  
15       quickly as possible. If you could go to the second  
16       last sentence of the paragraph, starting with  
17       "Retrospectively..."?

18                      A. I have it.

19                      Q. It reads: Retrospectively, we  
20       believe that the Saguenay Graben should  
21       have been included in the rift model for  
22       seismal tectonics. However, we wonder  
23       how many other such features will be  
24       evident only after they experience a  
25       future large earthquake.

1

2 Would you agree with that statement?

3 A. That is beyond my knowledge.

4 Q. Do you have any reason to disagree?

5 A. No. I have met Mr. Basham and Mr.

6 Adams in the past years, and they are respected members

7 of the Geological Survey of Canada.

8 Q. They were referring there, I take it,

9 to the November, 1988 magnitude 6 Saguenay earthquake;

10 correct?

11 A. Yes, I believe that is what they are

12 referring to.

13 Q. Now, if you turn to page 14 of the

14 exhibit, it is entitled Recently Discovered Geological

15 Features and Their Potential Impact on the Nuclear

16 Power Plants at Darlington and Pickering, Ontario, by

17 J.L. Wallach?

18 A. Yes, I have that.

19 Q. And are you familiar with Mr.

20 Wallach?

21 A. I have met Mr. Wallach.

22 Q. And he is an employee of the Atomic

23 Energy Control Board?

24 A. Yes.

25 Q. And this study, this is an abstract

1 from his study, and the first paragraph reads: A  
2 prominent north-northeast orientated arrow magnetic  
3 lineament has been identified in a map published  
4 recently; correct?

5 A. Yes.

6 Q. And the next paragraph, I believe he  
7 refers to this as the Niagara Pickering linear zone or  
8 NPLZ? Do you see that?

9 A. I see that.

10 Q. And this feature, he indicates at the  
11 top of the paragraph the magnetic lineament appears to  
12 line up with the central metasedimentary belt zone,  
13 passes practically beneath the Pickering nuclear  
14 generating station, and lies about 30 kilometres west  
15 of the Darlington nuclear generating station; is that  
16 fair?

17 A. Well, that is what is written here.

18 Q. Then, if you would go to the next  
19 paragraph he speaks about another feature, and at the  
20 bottom of the second paragraph he refers to this as the  
21 Georgian Bay linear zone (GBLZ). Do you see that ?

22 A. Yes, I see that reference.

23 Q. And at the top of that paragraph he  
24 states:

25 A series of aligned but discontinuous

1 north-northwest trending linear Bouguer  
2 gravity anomalies crosses western Lake  
3 Ontario, also in the vicinity of both the  
4 Darlington and Pickering nuclear  
5 generating stations, and extends from  
6 North York State (sic) into Georgian Bay.

7 And I assume that is: New York State into Georgian  
8 Bay?

9 A. I assume it is "New York", yes.

10 [Laughter]

11 Q. And if you look over to the next  
12 page, the very last sentence:

13 It is necessary that the region  
14 encompassing the Niagara, Pickering and  
15 Georgian Bay linear zones as well as the  
16 other newly discovered structural  
17 features be properly evaluated in order  
18 to determine whether or not the current  
19 design basis seismic ground motions for  
20 Darlington and Pickering are adequate.

21 Would you agree with that?

22 A. Do I agree with the statement or  
23 whether that is what is written here?

24 Q. Well, would you agree with the  
25 statement?



1 A. No, I don't.

2 Q. Before I get back to that, I will  
3 just keep taking you through Mr. Wallach's comments on  
4 these two features. If you would look to page 16 to 23  
5 of the exhibit, these are the minutes of the meeting?

6 A. Yes. .

7 Q. MAGNEC. Starting at page 20, I note  
8 under paragraph (c), entitled An Integrated Approach to  
9 Seismic Hazard Studies, Application to the Western Lake  
10 Ontario Region, Joe Wallach?

11 A. Yes, I have that.

12 Q. It begins: Wallach stated that the  
13 region encompassing the Darlington and Pickering  
14 nuclear generating stations has characteristics which  
15 suggest that it might be susceptible to an earthquake  
16 of magnitude 6 to magnitude 7 which might occur  
17 uncomfortably close to the nuclear power plants.

18 A few paragraphs down he goes on to talk  
19 about again the Niagara, Pickering lineament and the  
20 Georgian Bay lineament. Then if you turn to page 21,  
21 the third paragraph down, second sentence, it says:

22 Name the Georgian Bay linear zone. It  
23 intersects the NPLZ zone - that is  
24 Niagara Pickering lineament zone - in  
25 Lake Ontario near the nuclear plants at

1 both Darlington and Pickering.

2 Do you see that?

3 A. I see that.

4 Q. If you turn to page 22, second  
5 paragraph, the last two sentences:

6 Evidence of brittle deformation,  
7 different geophysical signatures for  
8 both --

9 A. I am not following. Tell me again  
10 exactly what sentence?

11 Q. End of the first full paragraph, last  
12 two sentences?

13 A. Starting with Evidence?

14 Q. That's correct.

15 A. Okay. Got it now.

16 Q. Evidence of brittle deformation,  
17 different geophysical signatures for both  
18 the NPLZ, CMBVZ and the GBLZ, and the  
19 distribution of epicentres along and in  
20 the proximity to both leads to the  
21 conclusion that there is a need to  
22 investigate both structures very  
23 thoroughly. The features associated with  
24 the GBLZ represent the second set of  
25 characters relevant to the suspicion that

1 an earthquake of magnitude 6 to 7 might  
2 occur in the vicinity of the nuclear  
3 power plants.

4 Next paragraph he says:

5 Where do the numbers magnitude 6 to 7  
6 come from? Were they simply made up?

7 No.

8 He goes and talks about why. In the same  
9 paragraph, he says:

10 The location aspect of such an  
11 earthquake uncomfortably close to the  
12 nuclear power plants is based on the  
13 intersection of the NPLZ, CMBVZ and the  
14 GBLZ in the vicinity of both Darlington  
15 and Pickering. This is because many  
16 large and moderate earthquakes do occur  
17 at intersections of major lineaments as  
18 clearly pointed out by Talwani in his  
19 1988 paper dealing with the intersection  
20 model of intraplate earthquakes.

21 In the bottom of the paragraph:

22 Thus, the intersection model of the  
23 lineaments, which is virtually at  
24 Pickering, could be the site of the  
25 aforementioned earthquake.

1 [2:55 p.m.]

2 Do you see that?

3 A. I see it.

4 Q. All right. And finally, the other  
5 finding he has on page 23, Mr. Wallach  
6 speaks about a third feature, in the  
7 second paragraph, first full paragraph of  
8 the page.

9 Initially Wallach was not prepared to  
10 accept their hypothesis until Gail McFall  
11 of the OGS pointed out the existence of  
12 an ENE, east northeast to north,  
13 northeast lineament which extends beneath  
14 the bottom of Lake Ontario.

15 And then skip the next few sentences into  
16 the next paragraph, the bottom sentence of the next  
17 paragraph:

18 The location of the rift as proposed  
19 by Adams and Basham --

20 A. Sorry, where are you reading right  
21 now?

22 Q. The end of the following paragraph.

23 A. Okay. I have got it.

24 Q. The location of the rift as proposed  
25 by Adams and Basham actually leads to a

1 triple junction near the power plants,  
2 rather than simply an intersection of two  
3 lineaments.

4 Now, Mr. King, I put it to you that the  
5 study done by Atkinson for Ontario Hydro in 1987 did  
6 not include or assess the seismic risks set out --  
7 these features set out by Mr. Wallach; is that correct?

8 A. Do you want all my comments on Mr.  
9 Wallach's statements?

10 THE CHAIRMAN: The first the question is  
11 whether Ms. Atkinson referred to it.

12 MR. KING: In Atkinson's 1987 report?

13 MR. MATTSON: Q. Yes.

14 MR. KING: A. I am not aware whether she  
15 considered any of that in her 1987 report.

16 Q. And in her update in 1990?

17 A. I am sure she was aware of  
18 everything.

19 Mr. Wallach published his report in 1989,  
20 I am assuming that she was a fully aware of that.

21 Q. Did she refer to it or deal with it  
22 in her update?

23 A. I made no note of that. I just don't  
24 know.

25 There are several things that have gone



1 on with respect to Mr. Wallach's report, which I think  
2 are important bring out.

3 Q. All right, Mr. King, go ahead, if you  
4 would like to comment on that.

5 A. Well, Mr. Wallach wrote his report  
6 like I said in 1989, it's an internal AECB report.  
7 That report has never, to my knowledge, been forwarded  
8 to Ontario Hydro and asking us for any response or  
9 action on that report. That's to my knowledge.

10 Of course, we have copy of the report,  
11 our specialists in this area.

12 What, to my understanding, is that when  
13 Mr. Wallach wrote this report, it was referred to the  
14 Geological Survey of Canada by senior AECB staff for  
15 comment.

16 The report was reviewed by Dr. Forsyth of  
17 the Geological Survey of Canada -- sorry, Dr. Stevens,  
18 the Geological Survey of Canada, and he wrote a report  
19 entitled, Review of Wallach Report on Seismic Hazard  
20 Near Darlington, Pickering, Geological Survey of Canada  
21 Report, October 2nd, 1989.

22 If I could just quote some things from  
23 Dr. Stevens' report. In fact, in the conclusion --

24 Q. Was this included in the  
25 interrogatory response?

1 A. No, it was not.

2 Q. Is it in evidence?

3 MR. B. CAMPBELL: It is now.

4 MR. KING: If I could just quote some of  
5 the conclusion of the Stevens report.

6 The numerical values of seismic design  
7 parameters provided by EMR - that stands  
8 for Energy, Mines and Resources -  
9 seismologists in 1985 for Darlington "A"  
10 are substantially the same as the  
11 numerical values that might be provided  
12 for the same parameters today, 1989, by  
13 EMR seismologists. Reports that  
14 estimated seismic hazard or reviewed  
15 seismic design for Ontario nuclear power  
16 plants have been recently published (1987  
17 and 1988) by authorities in seismology  
18 and engineering who are independent of  
19 the EMR, no safety concerns were  
20 expressed or implied. Contrary to the  
21 Wallach's conclusion, there is therefore  
22 no need for another new re-evaluation of  
23 the design base seismic ground motion  
24 parameters for Darlington or Pickering.  
25 Also, as a result of Mr. Wallach writing

1 his report, we initiated some other studies in the  
2 Darlington and Pickering areas.

3 What Mr. Wallach had been relying on is  
4 aeromagnetic surveys which were performed by a mining  
5 company, I believe, and it is clearly understood by  
6 experts in this field that seismic data, that is data  
7 which is obtained from creating small explosions by  
8 dynamite and then measuring the waves that return.  
9 Typically what you do in exploring for oil is a much  
10 more accurate means of looking at geology and  
11 geological features rather than aeromagnetic surveys.

12 There was an oil company from Texas in  
13 the 1970s that did extensive seismic testing in the  
14 area of Darlington and all through Lake Ontario as a  
15 matter of fact. So following our obtaining of the  
16 Wallach report we contracted or we obtained the seismic  
17 data from this Texas company, we paid them about  
18 \$150,000 to obtain that data. As part of an  
19 arrangement with the Geological Survey of Canada, we  
20 paid for the data, we gave it to Geological Survey of  
21 Canada to evaluate because this is much better data, I  
22 am advised, than the aeromagnetics data that Mr.  
23 Wallach relies on.

24 In a report prepared by Dr. Forsyth of  
25 the Geological Survey of Canada, the title of this

1 report is Results from Marine Seismic Profiles in the  
2 Eastern Great Lakes, Progress Report to Ontario Hydro,  
3 December 18th, 1991, this is where Dr. Forsyth analyzed  
4 the seismic data that we had obtained from the Texas  
5 company. He suggested in this report that there are no  
6 anomalies.

7 In fact, what is important when looking  
8 for fault structures, it's not that there is a fault,  
9 it's whether there is an active fault.

10 THE CHAIRMAN: Where there is a what, I'm  
11 sorry?

12 MR. KING: Where there is an active  
13 fault.

14 The very old rock which is underneath  
15 Pickering, Darlington or here, the Precambrian rock  
16 which is a billion years old or more, is riddled with  
17 faults. That's not the issue. Just as if you go  
18 Bancroft where the Precambrian rock is at the surface,  
19 you will see large fissures in the rock and that's the  
20 same sort of rock which is 700 feet below Darlington or  
21 Pickering.

22 But what they are looking for in the  
23 seismic surveys is the integrity of the sedimentary  
24 rock which has been laid down on top of this  
25 Precambrian, and in fact the results of Dr. Forsyth at

1 the geological survey in analyzing the seismic data, I  
2 am advised showed no disturbances in that seismic  
3 rock -- sorry, in the sedimentary rock which has been  
4 laid down over the Precambrian, which would indicate  
5 that there hasn't been any recent activity, faulting  
6 activity.

7 So based on that, we don't believe that  
8 the geological survey, which are the prime body in  
9 Canada in the federal government for these sort of  
10 subjects, that they have any concern about the adequacy  
11 of the Darlington/Pickering situations and hence we do  
12 not either.

13 MR. MATTSON: Q. Mr. King, if you could  
14 turn to page 26 of the exhibit, the five reports that  
15 were provided to our request for all reports on  
16 structural geology, seismicity and earthquake  
17 locations, were these reports provided that you can  
18 see?

19 MR. KING: A. They are not here. I can  
20 only assume that whoever responded to this request  
21 interpreted your request as given that your first  
22 sentence of the interrogatory is, please provide all  
23 reports on structural geology, seismicity and  
24 earthquake locations, I can only assume that since that  
25 was such a broad question, that they interpreted it to



1 mean those referred to in your second sentence. I'm  
2 afraid that's the only assistance I can provide.

3 Q. Can you provide us with the reports  
4 that you were speaking to a moment ago?

5 A. I don't have them with me, but I am  
6 sure they can be provided.

7 THE CHAIRMAN: That report by Stevens and  
8 by Forsyth, is that what you are referring to?

9 MR. KING: At the date of the  
10 interrogatory, the Forsyth report would not have been  
11 available, but the Stevens report probably would have  
12 been.

13 But the Stevens report is one, well, we  
14 are aware of, the way this happened, I understand, is  
15 that the AECB referred the Wallach report to the  
16 Geological Survey of Canada, the Geological Survey  
17 wrote back to the AECB with its reports. It's a report  
18 that we have obtained, but we were kind of a third  
19 party on this subject. But I will try to provide that  
20 report, I will consult our experts to see if we can  
21 have copies of it.

22 THE CHAIRMAN: We probably should have an  
23 undertaking number for that.

24 THE REGISTRAR: 532.10.

25 THE CHAIRMAN: That's the Stevens report

1 and the Forsyth report, referred to by Mr. King. Is  
2 that right, Mr. King?

3 MR. B. CAMPBELL: That's right. I think  
4 the first one was a report from the Geological Survey  
5 in response to a request from the AECB, and the second  
6 report which postdated the interrogatory is the one  
7 that Ontario Hydro requested, as I understand it, of  
8 the Geological Survey of Canada.

9 Is that right, Mr. King.

10 MR. KING: Yes, I read the titles of the  
11 reports into the record.

12 ---UNDERTAKING NO. 532.10: Ontario Hydro undertakes to  
13 provide "Results from Marine Seismic  
14 Profiles in the Eastern Great Lakes,  
15 Progress Report to Ontario Hydro,  
16 December 18th, 1991, Dr. Forsyth  
and Review of Wallach Report on Seismic  
Hazard Near Darlington, Pickering,  
Geological Survey of Canada Report,  
October 2nd, 1989, Stevens.

17

18 MR. MATTSON: Q. And, Mr. King, my  
19 information is that there has been an update of the Dr.  
20 Stevens report as well?

21 MR. KING: A. I am not aware of that. I  
22 have not been advised of that.

23 Q. If there is one will you provide that  
24 as well?

25 A. I will ask our experts. I have

1 consulted with them and they have not advised me that  
2 was the situation.

3 MR. MATTSON: Mr. Chairman, just for the  
4 record, as I am sure you are aware, we don't have any  
5 experts on this issue or any funding for any experts on  
6 this issue, so our only opportunity to test Hydro's  
7 evidence with respect to this issue is through  
8 cross-examination. And without their documents, it  
9 would be difficult in fact for us to put forward a case  
10 or to criticize any of the evidence Ontario Hydro has  
11 put before you except their cross-examination. I just  
12 note that have problem for the record that this time  
13 because we will not be bringing evidence forward on  
14 this issue, at least viva voce evidence through an  
15 expert as we have not retained one.

16 MR. B. CAMPBELL: I don't know whether we  
17 need any comment from me. I can advise the Board that  
18 this issue was argued, all of this matter was discussed  
19 and argued before the funding panel before making their  
20 funding award, including the Wallach lineaments and so  
21 on.

22 THE CHAIRMAN: Are you stipulating that  
23 you were unaware of the existence of the Stevens and  
24 Forsyth reports? I am talking to Mr. Mattson now.

25 MR. MATTSON: We were not aware, no, Mr.

1 Chairman.

2 THE CHAIRMAN: You knew about the update  
3 of the Stevens report.

4 MR. MATTSON: We heard that there had  
5 been an update. We did not have it. That's the extent  
6 of my information.

7 If there is one or if there isn't one it  
8 wouldn't surprise me either way. Unless, of course, my  
9 consultant, he may have a different opinion on that.  
10 He has just informed me that there may be one, and I  
11 have no person knowledge of it.

12 Q. Continuing, Mr. King, if we turn to  
13 page 2 of the exhibit, and this is set out -- it begins  
14 at page 1, I'm sorry, page 1 to 11 of the exhibit.  
15 It's a memorandum.

16 MR. KING: A. Yes, I have it.

17 Q. It's a total of three memorandums and  
18 it is AECB staff reports on seismic hazard for the  
19 Lepreau site, do you have that?

20 A. Yes, I have it in front of me.

21 Q. And if you look to page 4,  
22 conclusions and recommendations, bottom of the page.

23 A. I have it.

24 Q. It states:

25 My understanding is that the design

1 basis seismic ground motion for Point  
2 Lepreau is 22 per cent G, which is the  
3 most formidable design of all the nuclear  
4 power plants in Canada.

5 And, Mr. King, that is more than any of  
6 Ontario Hydro's stations; correct?

7 A. Yes. Point Lepreau is in an area of  
8 Canada which is much more seismically active than  
9 Ontario Hydro stations.

10 Q. And if you continue on from Table 1:

11 It can be seen that 22 per cent G  
12 would be exceeded though barely if  
13 earthquakes of magnitude 5.8, 6.00, 6.25  
14 and 6.50 or 7.0 were to be centred at  
15 distances of 20, 25, 35, 45, and 70  
16 kilometres respectively. Obviously if  
17 the distances are reduced the peak  
18 acceleration would be greater. For  
19 example, an earthquake of magnitude 7  
20 within about 50 kilometres would generate  
21 a ground motion equal to twice design  
22 basis for Point Lepreau.

23 Do you see that?

24 A. That's what it says.

25 Q. Now, if we look to the table, table 1



1 is at page 7 and you will note on page 8 of the exhibit  
2 is table 2.

3 Table 1 is entitled Peak Ground  
4 Acceleration as a Function of Magnitude and distance  
5 from Hasegawa Basham and Berry 1981, and table 2 is  
6 Peak Ground Acceleration as a Function of Magnitude and  
7 Distance from Boore and Atkinson 1987.

8 Do you see that?

9 A. Yes, I see that.

10 Q. And that Atkinson is the same expert  
11 who prepared you are 1987 and 1990 update on seismic  
12 risks for Ontario Hydro nuclear generating stations;  
13 correct?

14 A. That's Ms. Atkinson, yes, the same  
15 person.

16 Q. Now, the most concerning magnitude of  
17 course is the 7 magnitude, and if I look at in Table 1,  
18 all the magnitudes of 7, and I see what ground  
19 acceleration they predict, it varies greatly from the  
20 ground acceleration predicted by Atkinson/Boore report,  
21 correct?

22 A. In these two tables it does, yes.

23 Q. So you could confirm then generally  
24 that it's about a 2 to 1 ratio, it looks to me. I will  
25 go through, I have highlighted them I am not sure if I

1 highlighted them in yours, but it's around a 2 to 1  
2 ratio difference between table 1 and table 2 for the  
3 magnitude 7; correct?

4 A. Well, it's approximately a factor of  
5 2, yes.

6 Q. All right. Now, if you turn to page  
7 5 of the exhibit, the bottom of the page, footnote, it  
8 states:

9  
10 The Hasegawa Basham and Berry equation  
11 was much more accurate than the Boore and  
12 Atkinson equation for representing  
13 accelerations produced by the magnitude  
14 of .5, Saguenay earthquake in 1988.

15 Correct?

16 A. That's what it says.

17 Q. Now, in response to the Saguenay  
18 earthquake in 1988, Mr. King, isn't it also true that  
19 Ontario Hydro responded by having Ms. Atkinson review  
20 her 1987 study?

21 A. Well, I am aware of her later study,  
22 the exact reason for it, perhaps it's stated the study,  
23 I don't recall.

24 Q. If we go to the study, that's set out  
25 at pages 76 to 102, that's the update.

1 MR. PENN: A. Before we do this, Mr.  
2 Mattson, I am interested in following along, and tables  
3 1 and 2, are they discussed in the memorandum somewhere  
4 by the AECB on what their views are on the equity of  
5 that information?

6 Q. I am not sure, Mr. Penn. I know the  
7 AECB report was by Wallach but that didn't deal with  
8 the Saguenay earthquake, as far as I'm concerned, that  
9 was the three other features.

10 A. Mr. Wallach's memoranda I am talking  
11 about, and you have just made a point that there was  
12 factor of 2 between table 1 and 2, and it seems to me  
13 that it would be reasonable for some discussion of the  
14 importance that matter.

15 Q. I agree. And I am trying to go to  
16 your update in 1990 to see if I could have you agree  
17 that Ms. Atkinson was hired to assess that importance.

18 A. That is fine, but I would have  
19 thought the AECB would have been interested.

20 THE CHAIRMAN: There is a reference to  
21 tables 1 and 2 in the second full paragraph on page 5,  
22 the last part of that paragraph. It doesn't say who  
23 generated tables 1 and 2 or who prepared them, but I  
24 just assumed Mr. Wallach had prepared them, but I might  
25 be wrong about that.

1 MR. KING: I have placed absolutely no  
2 importance to these tables and I assume that you will  
3 be heading in some direction to draw some tie, and I am  
4 reserving my comments until you get to the point that  
5 you want to make.

6 [3:20 p.m.]

7 MR. MATTSON: Q. If you look to page 81  
8 of Ms. Atkinson's update under Purposes, Scope of  
9 Study, I will read the second paragraph:

10 The study also incorporates new work  
11 on tectonic interpretations, including  
12 the rift model of eastern seismotectonics  
13 proposed by Adams and Basham, 1989,  
14 which -- Mr. King, maybe just pause for a moment.

15 We saw a report or a summary of that at  
16 page 13 of the exhibit; correct?

17 MR. KING: A. This is referring to  
18 eastern -- I'm not sure what he means by eastern,  
19 whether he means eastern around Point Lepreau or more  
20 general than that. I don't know.

21 Q. I will just continue:

22 ...and a novel approach proposed in  
23 this study. In addition, ground motion  
24 relations are reconsidered in light of  
25 recent ground motion data from the

1 Nahanni/Northwest Territories earthquakes  
2 and the Saguenay, Quebec earthquake.

3 Do you see that?

4 A. Yes, I see that.

5 Q. Then if we could turn to page 84  
6 under Developments in Ground Motion Relations, I am  
7 looking at the second paragraph from the bottom:

8 There has been some new ground motion  
9 data related in ENA since the development  
10 of the relations of table 5-1. The new  
11 data includes records from the 1985  
12 Nahanni earthquakes and the 1988 Saguenay  
13 earthquakes. The later records are  
14 particularly important since they  
15 represent the first well-recorded large  
16 earthquake in Eastern Canada. The  
17 records for these recent events have  
18 generated some concern as to the  
19 appropriateness of the ground motion  
20 relations since there are significant  
21 discrepancies. For this study the ground  
22 motion relations have been re-evaluated  
23 in light of the new data as described in  
24 appendix E.

25 And I think we should turn to that. Page 92 the



1 appendix begins.

2 And at page 94, Mr. King, finally if I  
3 could take to you that, page 94, and I am starting  
4 halfway down the first paragraph where it starts, "But  
5 the Saguenay earthquake". Do you see that?

6 A. Yes.

7 Q. But the Saguenay earthquake moment  
8 magnitude 6 was seen as a test of its  
9 applicability to larger events.

10 Then after the quotations:

11 The fact that the stochastic model did  
12 a poor job of predicting the Saguenay  
13 ground motions has raised important  
14 questions concerning the validity of the  
15 underlying seismological model. Before  
16 jumping to conclusions based on a single  
17 earthquake it is worthwhile to step back  
18 and consider the implications of the new  
19 data in the broader context of the data  
20 set as a whole.

21 A. I see that.

22 Q. Now, so again, Mr. King, so partially  
23 then -- I think I will rephrase. Partially in response  
24 to the concerns raised by the Saguenay quake, Ontario  
25 Hydro hired Ms. Atkinson to update her reassuring

1 report in 1987.

2 THE CHAIRMAN: To update the report  
3 perhaps you should --

4 MR. MATTSON: Sorry, I don't mean to be  
5 pejorative.

6 MR. KING: Well, we have hired her as a  
7 consultant to prepare this report, and in this report  
8 she looked at the Saguenay earthquake and made her  
9 appropriate comments on how that impacts any of her  
10 previous work, I guess.

11 MR. MATTSON: Q. Mr. King, wouldn't it  
12 have made more sense to hire someone who predicted the  
13 Saguenay earthquake ground motions more accurately such  
14 as the person set out at page 5 of the exhibit, which  
15 was the Hasegawa, Basham and Berry?

16 A. They are members of the Geological  
17 Survey of Canada.

18 Q. Yes.

19 A. Well, I have no idea who would be  
20 best. This is one event, and, as Ms. Atkinson is  
21 suggesting, taking too much out of one event is not  
22 appropriate.

23 Our experts within Hydro besides  
24 contracting with Ms. Atkinson on occasion are in  
25 frequent contact with the Geological Survey of Canada

1 experts, and for me to suggest what is the best course  
2 of action is beyond my expertise.

3 Q. But you would agree that it is a  
4 relatively short time period with which these  
5 earthquakes are recorded; correct?

6 A. As I have said earlier, the recorded  
7 history -- the instrumental record history is very  
8 short.

9 Q. And, Mr. King, at page 84, as I have  
10 read, Ms. Atkinson admits that the records of the  
11 Saguenay earthquake are particularly important since  
12 they represent the first well-recorded large earthquake  
13 in Eastern Canada; correct?

14 A. Yes.

15 MR. B. CAMPBELL: With respect, Mr.  
16 Chairman, she doesn't admit; she states it in the  
17 report clearly. She admits it?

18 MR. MATTSON: Q. Mr. King, she also  
19 admits that her model did a poor job of predicting it;  
20 correct?

21 MR. KING: A. Well...

22 THE CHAIRMAN: She said the stochastic  
23 model did a poor job of predicting it.

24 MR. MATTSON: Q. Mr. King, the  
25 stochastic model is her model; correct?

1 MR. KING: A. Well, I am not sure that  
2 the Basham and Berry equation is not stochastic either.  
3 Stochastic just means that, you know, it is a  
4 probabilistic relationship between magnitude and  
5 exceedance probability.

6 Q. Would you agree, Mr. King, with the  
7 comments at page 5 of the exhibit that the Hasegawa,  
8 Basham and Berry equation was much more accurate than  
9 the Boore and Atkinson equation for representing the  
10 accelerations by the magnitude 6.5 Saguenay earthquake  
11 in 1988, as we saw --

12 A. That is what Mr. Wallach says right  
13 here, and Ms. Atkinson says something in her report.  
14 I'm afraid...

15 Q. Are you saying --

16 A. I have no knowledge to argue either  
17 way. You know, in some cases, as we have on some of  
18 the previous work of Mr. Wallach as it related to  
19 ourselves and Ontario Hydro, but all this work by Mr.  
20 Wallach here in these memos here that you are taking me  
21 through are dealing purely with the Point Lepreau site.

22 I'm sure Ms. Atkinson from a professional  
23 interest would be involved in that and I guess in her  
24 derivation of models which would apply to broad areas  
25 of Eastern Canada, but I am not aware of Ontario Hydro

1 being involved in these detailed discussions on what is  
2 happening at the Point Lepreau site.

3 Q. If you turn to page 96 of the exhibit  
4 Ms. Atkinson's update under point 2, Mr. King, you  
5 note -- I will read:

6 The Saguenay ground motions, all the  
7 magnitude 6 data for frequencies of 5 to  
8 10 Hertz, are much larger than predicted  
9 by almost a factor of 10 and show an  
10 unusually large degree of scatter.

11 Do you see that?

12 A. Yes.

13 Q. And again, this was something that  
14 the 1987 assessment of seismic risk done by Ms.  
15 Atkinson failed to predict; correct?

16 A. Well, it is whatever Ms. Atkinson  
17 says in here. You know, you are going back from page  
18 to page to page to page, and then I have got to go back  
19 and see exactly what she said. I have no reason to  
20 dispute anything that Ms. Atkinson says in this report.

21 Q. If you turn to page 98 she concludes  
22 at the bottom of the page, last sentence:

23 In view of the large contribution of a  
24 single earthquake, Saguenay, to the  
25 scatter, however, it may be premature to



1 draw any general conclusions as to  
2 whether the scatter obtained in this  
3 study is to be expected for future  
4 events.

5 Correct?

6 A. That is what she says.

7 Q. And is that Ontario Hydro's position?

8 A. I have no idea. I have not consulted  
9 with anybody on that sentence.

10 MR. B. CAMPBELL: I would have thought,  
11 Mr. Chairman, that the main conclusion is the first  
12 sentence of the discussion.

13 MR. MATTSON: Mr. King, if you would like  
14 me to read that onto the record I don't have a problem.

15 MR. KING: There is a letter, an internal  
16 Hydro memo, which goes along with this update. This is  
17 at page 77 and 78 of your exhibit. I take this to be  
18 the view of the Ontario Hydro experts on the update to  
19 Ms. Atkinson's report.

20 MR. MATTSON: Q. Thank you. There has  
21 been no further study or update with respect to Ms.  
22 Atkinson's report of 1990; is that fair to say?

23 MR. KING: A. I'm not aware of any.

24 MR. MATTSON: Thank you.

25 Mr. Chairman, maybe it is an appropriate

1 time for the afternoon break. I don't have much more  
2 to cross-examine on. However, it has taken me a little  
3 longer than I expected. I apologize.

4 THE CHAIRMAN: We will take a 15-minute  
5 break.

6 THE REGISTRAR: Please come to order.  
7 This hearing will adjourn for 15 minutes.

8 ---Recess at 3:30 p.m.

9 ---On resuming at 3:49 p.m.

10 THE REGISTRAR: Please come to order.  
11 This hearing is again in session. Be seated, please.

12 MR. B. CAMPBELL: Mr. Chairman, I have a  
13 correction to make to something I stated earlier this  
14 afternoon. I indicated that this matter had been  
15 argued in front of the Funding Panel. It was of course  
16 this panel, and in the third paragraph of your April  
17 10th Decision on the Funding Application brought by  
18 Energy Probe the Board noted that: Hydro maintained  
19 that it had been aware of the anomaly, has been  
20 pursuing its own research, work being pursued by the  
21 AECB, the regulatory agency responsible for nuclear  
22 safety, and the Canadian Geological Survey was also  
23 described.

24 And that was the reference that I should  
25 have made rather than to the Funding Panel, and I

1 apologize if I have been misleading in that regard.

2 THE CHAIRMAN: I understand, Mr. Poch,  
3 that you would prefer not to start when Mr. Mattson has  
4 finished, and we are in entire agreement with that.  
5 [Laughter]

6 MR. D. POCH: Mr. Chairman, I am  
7 delighted to treat this as a mutual season's gift.

8 THE CHAIRMAN: That's right. And I don't  
9 want to discourage you, Mr. Mattson, in any way, but as  
10 soon as he is finished we will be able to adjourn for  
11 the weekend. [Laughter]

12 MR. MATTSON: Short questions and short  
13 answers. That is...

14 THE CHAIRMAN: That is a bit unfair, Mr.  
15 Mattson. I shouldn't do that.

16 MR. MATTSON: Mr. Chairman, I am moving  
17 to another topic, and, as I noted earlier, there is  
18 only one other exhibit package, and that is an exhibit  
19 package entitled Planning Issues and Darlington, the  
20 very last one. It is very brief.

21 If could I get an exhibit number for  
22 that?

23 THE REGISTRAR: That will be 628

24 ---EXHIBIT NO. 628: Exhibit package entitled "Planning  
25 Issues and Darlington".

1  
2 MR. MATTSON: Thank you.

3 Q. Mr. Penn, I take it these questions  
4 will be addressed at you.

5 If you turn to page 1 of the exhibit it  
6 is an interrogatory from the Association of Major Power  
7 Consumers, 9.24.4, which already has been made an  
8 exhibit, No. 520.32. The question is:

9 Please calculate the cost of  
10 Darlington in 1990 dollars if it had not  
11 suffered delays caused by government  
12 decision.

13 It goes on, but your response in the first paragraph:

14 Approximately 75 per cent of the  
15 delays to the in-service date of the  
16 Darlington generating station were  
17 planned. They occurred late in 1978 and  
18 in the early 1980s. These delays  
19 resulted primarily from lower projected  
20 demand for electricity and borrowing  
21 restraints.

22 Mr. Penn, the question is: Is it true  
23 that the borrowing constraint being referred to was  
24 primarily caused by the financial stresses relating to  
25 constructing Pickering "B", Bruce "B" and Darlington

1 simultaneously?

2 MR. PENN: A. I don't have knowledge of  
3 that.

4 It is usual when there is a borrowing  
5 restraint that since Hydro is borrowing and the  
6 provincial government is borrowing, the most  
7 significant borrowing in this province, that it is a  
8 collective view of that, and it is the result of  
9 consultation between the Treasury of the province and  
10 the Chief Economist and Treasurer of Ontario Hydro.

11 I don't have any other knowledge of that  
12 subject.

13 Q. If you don't have any other knowledge  
14 I will go ahead.

15 Mr. Penn, there have been a host of  
16 suggestions made in the course of cross-examination of  
17 the last few weeks about political interference in the  
18 Darlington project, and my understanding of  
19 Darlington's history is that the only time any  
20 political authority publicly recommended that  
21 Darlington be slowed was the interim report of the  
22 Select Committee on Energy in December, 1985 when they  
23 recommended that no new orders be placed for Units 3  
24 and 4 until the review could be completed.

25 Is that your understanding?



1                   A. Well, on page 2 of your Exhibit 628  
2       there is a newspaper article by Thomas Claridge of the  
3       Globe and Mail which states that, and I do recall that  
4       in the Select Committee hearing on Darlington that  
5       occurred in '85 that the Committee inquired of Hydro  
6       with regard to the savings, or the cost rather, if  
7       there was a delay in ordering further contracts to  
8       Units 3 and 4, and I can confirm as this article states  
9       that most of the major equipment orders had been  
10      awarded and that there was a relatively small saving of  
11      that six-month delay.

12                  Q. Mr. Penn, in August of the following  
13      year the government recommended completion of all  
14      units. Is that your understanding?

15                  A. Yes. There was a Cabinet decision  
16      that followed deliberations of that Select Committee I  
17      have just spoken about, and the Cabinet and the  
18      Premier, I believe, announced that Darlington should  
19      continue to be completed for several reasons, one of  
20      which of course was that there had been considerable  
21      money sunk in Darlington, and to build only half a  
22      station when you had invested a very significant amount  
23      of money would be like getting half an asset for the  
24      payment of a full one.

25                  Q. Thank you, Mr. Penn. Moving to page

1 4 of the exhibit, it is an OEB HR 18 interrogatory or  
2 transcript undertaking for the OEB Panel, and the  
3 question was:

4 Ontario Hydro undertakes to review the  
5 provincial auditor's report on the review  
6 of Darlington and update the history of  
7 Darlington's cost estimate as  
8 appropriate.

9 And the second paragraph of the response:

10 During testimony it was stated that an  
11 early estimate for the cost of Darlington  
12 was made in '73, was 2,074-million. It  
13 should be noted that this was a very  
14 preliminary conceptual estimate made for  
15 a generating station with an in-service  
16 date of 1982 and was for construction  
17 costs only and did not include costs for  
18 commissioning or for heavy water. The  
19 project was not approved until 1977 and  
20 the work was released in 1978. At the  
21 time of the release the in-service dates  
22 for the Darlington units were November,  
23 '85 to February, '88, and the estimated  
24 total cost was 5 billion. This, too, was  
25 a relatively early estimate, and it was

1 not until 1981 that the definitive  
2 estimate of 7.5 billion was prepared.

3 [4:00 p.m.]

4 Is that your understanding as well, Mr. Penn?

5 A. Well, I am not quite sure that is  
6 totally accurate. But we have in discussion and in  
7 cross-examination by Atomic Energy of Canada, and the  
8 Canadian Nuclear Association, we have in Exhibit 539 a  
9 totally updated history of all Darlington delays, and  
10 all Darlington estimates, and the when estimates  
11 referred to various in-services and the validity and  
12 viability of those estimates. I would be most happy to  
13 go through this again.

14 Q. It's not necessary, Mr. Penn. But my  
15 information is that it doesn't include this, 539 does  
16 not include this early history of Darlington and I just  
17 wanted to ask if this is your understanding as well,  
18 with respect to the early history?

19 A. No, it's not understanding.

20 If you go to Exhibit 539, the first page,  
21 under the third bullet, just over halfway down, the  
22 third bullet, it starts with:

23 Recent newspaper articles have drawn  
24 comparisons of the current Darlington  
25 estimate for the station in full service

1 in 1993, with a 1973 conceptual estimate  
2 of 2-1/2 billion, station in full service  
3 by 1994, or on the other hand, compared  
4 it with a 1975 conceptual estimate of 3.2  
5 billion, station intended to be in full  
6 service by 1986.

7 Then it goes on in the fourth bullet to  
8 refer to:

9 The definitive estimate produced in  
10 1981 of 7.4 billion.

11 And if you read on further, that  
12 particular estimate was with an expectation of a 1988  
13 project completion. And, of course, moving along in  
14 history from 1981 which is what I have just mentioned,  
15 there are a whole range of capital estimates done every  
16 year to compare with the definitive estimate on  
17 appendix 3 in escalated dollars, appendix 4 in constant  
18 dollars, and in appendix 5.1, a complete accounting of  
19 the historical cost increases from 1981 due to both  
20 planned and schedule slippages that we discussed in  
21 some considerable detail before.

22 Q. Mr. Penn, you will note that that  
23 exhibit discusses the appropriate starting point, in my  
24 only question to you is with respect to this  
25 information provided, this document provided by Ontario

1 Hydro to the OEB Panel. It states at the top of the  
2 second paragraph, during testimony it was stated that  
3 an early estimate for the cost of Darlington was made,  
4 in 1973 it was 2 billion 74 million. And then it  
5 discusses some facts.

6 Was that a fact at the time, was that  
7 Ontario Hydro's early estimate?

8 A. I have no reason to doubt that the  
9 cost estimates given in Exhibit 539 from that period of  
10 time are incorrect.

11 Now, whether in the second paragraph we  
12 are talking here just about designing and construction  
13 costs, as opposed to operating and heavy water costs,  
14 commissioning costs, I can't confirm at this point.

15 I do note that the 1973 estimate here, in  
16 this interrogatory, is 2.074 billion, whereas the  
17 conceptual estimate quoted in Exhibit 539 is 2.5  
18 billion.

19 Now, I also notice that there is a  
20 difference here of a suggested in-service date as early  
21 as 1982 in Interrogatory 6.3.16, whereas in Exhibit  
22 539, which has just being issued by the project manager  
23 at Darlington, the 1973 conceptual estimate was for  
24 full in-service by 1984.

25 Q. Thank you, Mr. Penn. But you have no



1 reason to disagree with the voracity of page 4 of the  
2 exhibit; correct?

3 THE CHAIRMAN: Perhaps I am missing  
4 something. They are reasonably consistent with what is  
5 said on the first page of Exhibit 539.

6 The only significant difference is the  
7 1973 estimate of 2.07 billion as opposed to 2.5  
8 billion, and that may be explained by the limited scope  
9 of the costs in 1973. They weren't taking them all  
10 into account according to Mr. Penn.

11 There is 7.5 billion in 1981 against 7.4  
12 billion, that's not a significant difference.

13 MR. MATTSON: No, Mr. Chairman, I agree.  
14 In fact, what you pointed out, I didn't want to get  
15 into an argument about whether or not that was true, as  
16 they are probably leading evidence on that. I just  
17 wanted to establish the veracity of this.

18 THE CHAIRMAN: Speaking for myself, I  
19 would rather go with 539 as an expression of Hydro's  
20 opinion about this matters because it's an update as  
21 expressed in 1992. Now, there may be a difference of  
22 opinion, but that I think is the best source of Hydro's  
23 view about Darlington costs at the moment.

24 MR. PENN: I don't know whether this will  
25 help, Mr. Chairman, but it has just been pointed out to

1 me, and without looking at the provincial auditor's  
2 report which I don't believe is on record, the 2.074  
3 billion is quoted in the environmental assessment  
4 document for Darlington "A", and it's in 1976 dollars,  
5 and it is really associated with the definition phase.  
6 I think it, quite frankly, is history.

7 MR. MATTSON: Thank you. That is fine,  
8 Mr. Penn. Thank you very much.

9 Q. Now, Mr. Penn, has Hydro ever built a  
10 nuclear generating station on time relative to the  
11 schedule in the release estimate?

12 MR. PENN: A. I don't know whether it is  
13 possible for me to answer that without going into the  
14 archives. We would have to go back to literally 1964  
15 for Pickering "A".

16 I do know that from memory that the  
17 in-service units of Pickering "A" were very close to  
18 target, but I just can't go any further than that.  
19 Certainly it's on the record. It's well known and  
20 there is exceptionally good reasons why that's not the  
21 case with Darlington.

22 I believe, and I think the costs bear it  
23 out, that we did very well to expectations on Bruce  
24 "B".

25 Q. Mr. Penn, has Hydro ever built a

1 nuclear generating station on budget relative to cost  
2 in the release estimate?

3 A. I doubt very much whether they have.  
4 That's something that would have to be confirmed. But  
5 Mr. Mattson, you seem to misunderstand the purposes of  
6 release estimates.

7 Definitive estimates are the costs to  
8 which a project's progress and performance is measured.  
9 A release estimate is one in which our Board agrees  
10 that we should start the early conceptual and  
11 definition phase work in order to be able to come up  
12 with a firm estimate of cost, which subsequently occurs  
13 at the definitive stage. And, of course, the Board or  
14 the staff would have every reason to make a major  
15 decision on whether to proceed or not based on that  
16 work.

17 Q. Thank you. Finally, Mr. Penn, if you  
18 could turn to Volume 129, page 22748. If you look at  
19 line 21, Mr. Penn, you were having a discussion with  
20 Mr. Poch, counsel for the Coalition of Environmental  
21 Groups, on delays, and your answer:

22 I don't think it is a matter of  
23 probability. It is a matter of decision.  
24 I don't know whether I should mention the  
25 word political decision.

1 But certainly in Japan there has been  
2 an excellent record of building plants  
3 quickly. We have built plants in the  
4 past quickly. I don't see any reason why  
5 we can't build plants in the future  
6 quickly, given that there is a will to do  
7 it.

8 And to assume that there won't be a  
9 will to do it seems to me to place an  
10 estimate on a level which loses  
11 understanding.

12 Mr. Penn, my only question with respect  
13 to that is if you could explain to me what you mean in  
14 the context of a will to do it, whose will is that we  
15 are speaking of here?

16 A. I am just trying to recall the exact  
17 context of my discussion with Mr. Poch.

18 I think what my view of what I meant  
19 there was of a will to do it is that it's well-known in  
20 the world today, and there have been major studies done  
21 in all key countries, France, Japan, United States, and  
22 certainly here in Ontario, because I was party to  
23 suggesting that if you want to gain the greatest  
24 confidence in reducing the schedule to a minimum, and  
25 the cost of a major project, then it is important to do

1 a number of things.

2 What I mean by the will to do it, you  
3 have to have the will to say, "Yes we will do as much  
4 engineering as is possible prior to constructing the  
5 plant, so that the people charged with that  
6 responsibility know what it is they are going to  
7 build."

8 Next thing you have to do is to have the  
9 will to say, "And once we have started building it we  
10 won't stop building it, or we won't have any delays  
11 while we build it," because that leads to the lowest  
12 cost and the greatest benefit over the whole period  
13 from which you gain benefit from these assets, and  
14 that's really what I was talking about.

15 And many countries today, and  
16 particularly the United States, have pointed out  
17 that -- and no one would invest in very large projects  
18 unless you have an understanding upfront with a  
19 licencing regulator on what is required to be met in  
20 safety, and that you do everything you can to ensure  
21 that the construction of the plant runs as smoothly as  
22 possible. And of late, people in Japan, and I think I  
23 referred to Japan here somewhere, have done rather well  
24 at that process.

25 Q. Mr. Penn, with respect to Darlington,



1 the long construction period, would you attribute this  
2 to the result of lack of will, and if so, on whose  
3 part?

4 A. I think Exhibit 539 clearly states  
5 the reasons for the extended schedule of Darlington.  
6 In the sense that there wasn't the will to proceed  
7 ahead, the net result has been that the costs have  
8 increased.

9 Now, at the time the decisions were taken  
10 to delay on several occasions, and no doubt the  
11 information available suggested that this was the best  
12 course of action at that time.

13 It's my personal view, and I haven't seen  
14 an analysis done of it, that we may very well have been  
15 better off had we proceeded to the original schedule.

16 Q. And, I take it, Mr. Penn, you  
17 wouldn't limit that statement by even if there wasn't a  
18 need for the plant, the point is to get it finished?

19 A. Well, no one would start a project if  
20 there wasn't a need for it.

21 Q. But in the middle of the project and  
22 there is no longer a need, do we still go ahead; is  
23 that what you are saying?

24 A. Well, I think we are getting into  
25 perhaps philosophical discussion here. But when you

1 know from historical records that the economy of this  
2 province is directly related and has exactly the same  
3 function as the electrical load growth, then to suggest  
4 that the project would not eventually be needed is  
5 without reason.

6 Q. Thank you.

7 Moving to another area, Mr. Chairman,  
8 it's already an exhibit, Exhibit 608.

9 THE CHAIRMAN: 608. That's behind what  
10 tab? You don't know because you don't have tabs.

11 MR. MATTSON: That's correct.

12 THE REGISTRAR: Tab A.

13 THE CHAIRMAN: Tab A.

14 MR. MATTSON: I won't be referring to a  
15 page yet but I thought you might have it handy.

16 THE CHAIRMAN: Do you have a page in your  
17 material?

18 I have 608.

19 MR. MATTSON: I just wanted to have it  
20 front of you. I will be referring to a page in a  
21 moment.

22 Q. Just a number of questions about  
23 Ontario Hydro's relationship with the CANDU technology.  
24 I will ask these questions to Mr. Daly or Mr. Penn.

25 First of all, can you tell me what

1 percentage of the CANDU capacity in the world is owned  
2 and operated by Ontario Hydro? Just a rough number, if  
3 you could, Mr. Daly.

4 MR. DALY: A. A rough number is probably  
5 about 80 per cent. There is plant in Quebec, plant in  
6 New Brunswick, plant in Argentina, plant in Korea, and  
7 two or three plants in India, Pakistan, so it is  
8 probably of the order of 80 per cent.

9 Q. And, Mr. Daly, is it fair to say that  
10 Ontario Hydro has had a very long-standing relationship  
11 with the designer of the CANDU, AECL?

12 A. Yes.

13 Q. And, Mr. Daly, Ontario Hydro  
14 purchases a great deal of services from AECL?

15 A. We have done over the years, yes.

16 Q. An Ontario Hydro funds AECL research  
17 and development as well, does it not?

18 A. We provided funding to the CANDU  
19 owner's group, yes.

20 MR. PENN: A. I would like to comment on  
21 that.

22 We don't fund AECL. We retain AECL as a  
23 consultant to carry out research that's necessary to  
24 operate our system and to carry out our  
25 responsibilities.

1 Q. Thank you, Mr. Penn, I might come  
2 back to that momentarily.

3 Ontario Hydro employees participate in  
4 exchanges with AECL and in joint projects with AECL as  
5 well, do they not?

6 MR. DALY: A. Well, there are many  
7 projects within the company where we rely on AECL's  
8 support, if that's the type of project you are getting  
9 at, yes.

10 Q. And Ontario Hydro employees  
11 participate in exchanges with AECL, do they not?  
12 [4:20 p.m.]

13 A. We have from time to time attached  
14 and are familiar with the -- we have from time to time  
15 attached employees to Chalk River Nuclear Laboratories,  
16 for example, to gain knowledge and expertise in -- a  
17 particular example I can think of in the fuel area, and  
18 similarly I am aware of some attachments of AECL  
19 employees to the two operations or design.

20 Q. Would it be fair, Mr. Daly, to  
21 describe the relationship between Ontario Hydro's  
22 nuclear program and AECL as a symbiotic relationship,  
23 i.e. both entities relying on each other?

24 A. Well, I think the type of  
25 relationship between AECL and Ontario Hydro is not

1 unlike the relationship between other major utilities  
2 and similar companies in other countries, such as  
3 Britain and other major nuclear power producing  
4 countries.

5 MR. PENN: A. I would like to clarify  
6 what you mean by symbiotic. As I stated earlier,  
7 Atomic Energy of Canada is the major consultant that  
8 Ontario Hydro retains for work on Hydro stations.

9 Now, AECL in turn has its own business.  
10 So in the sense that information learnt through the  
11 process symbiotically helps both companies then I would  
12 agree with you. But that is how I would see the use of  
13 the word 'symbiotic'.

14 Q. That's fair, Mr. Penn. If you would  
15 turn to page 91 of the exhibit it is a news release  
16 from Energy, Mines and Resource Canada, dated March  
17 30th, 1990, entitled "Epp Announces Results of AECL's  
18 Study".

19 I am looking at the second sentence of  
20 the first paragraph:

21 The Minister stated that the AECL will  
22 be revitalized and a new  
23 federal/provincial partnership will  
24 ensure adequate funding and direction for  
25 R&D in Canada and negotiations will



1 continue for the sale of a prototype  
2 CANDU 3 reactor to New Brunswick.  
3 A. Could you tell me whereabouts that  
4 is? I haven't found it yet.

5 THE CHAIRMAN: 608.

6 MR. PENN: I have got page 91.

7 MR. MATTSON: Q. The second sentence,  
8 Mr. Penn?

9 MR. PENN: A. Oh, thank you. Yes?

10 Q. And then, specifically I am looking  
11 at the third paragraph down, and it states:

12 Last year Mr. Epp announced a study on  
13 how the nuclear industry could be  
14 restructured. The restructuring  
15 framework for AECL and the Canadian  
16 nuclear industry has been developed by an  
17 AECL/Ontario Hydro working group under  
18 the direction of the Canada/Ontario  
19 Steering Committee and in consultation  
20 with other Canadian utilities in the  
21 private sector.

22 My question is: Is anyone on the Panel familiar with  
23 this working group?

24 A. Well, I am familiar with the fact  
25 that there were discussions between Ontario Hydro and

1 AECL on the longer-term responsibilities for various  
2 design features of any future plant.

3 For example, AECL would be retained by  
4 Ontario Hydro to design the reactor itself. On the  
5 other hand, Ontario Hydro would always design the  
6 balance of plant.

7 Now, I am not aware of an AECL/Ontario  
8 Hydro working group, although it is clear that it  
9 states it here, and a Canada/Ontario Steering Committee  
10 that would lead to a restructuring. I don't know if  
11 any of my colleagues can recognize a restructuring that  
12 we have had.

13 Q. Of AECL I believe it speaks to.

14 A. We certainly haven't had one in  
15 Hydro, along these lines anyway.

16 Now, the formation of the AECL  
17 engineering company at Sheridan Park was done way  
18 before this and a consolidation of the two research  
19 companies, so I'm afraid I can't help you.

20 Q. All right, Mr. Penn. What about the  
21 next sentence, that Ontario Hydro has agreed to  
22 increase its contribution to AECL research and  
23 development by approximately 30 million annually over  
24 the next seven years to be channeled through the CANDU  
25 Owners Group? Is that your understanding?

1                   A. Yes. We certainly increased our  
2     annual funding of the CANDU Owners Group, which by the  
3     way is managed by Ontario Hydro, and we did it in  
4     recognition of the importance of concentrating more  
5     money and more research on the sort of problems that  
6     Mr. Daly talked about with our operating plant.

7                   And, in fact, that is where this money  
8     goes, together with our contribution to the research  
9     and development for the development of a final used  
10    fuel disposal facility that we spoke about in our  
11    direct evidence.

12                  Q. So when it says 'increase its  
13    contribution', what was increased? The \$30 million  
14    increase, what is that an increase to? Do you know how  
15    much?

16                  A. Our present CANDUs Owners Group  
17    budget is about \$80 million a year.

18                  Q. Mr. Penn, I am turning to the next  
19    page of the exhibit, page 92, third paragraph down,  
20    starting with "The Minister..."?

21                  A. And before we leave that--

22                  Q. Yes?

23                  A. --that includes all necessary  
24    research to be done with regard to reactor safety,  
25    matters that Mr. King has spoken about for used fuel

1 management, for pressure tube related investigations,  
2 and all other issues relating to operating plant.

3 Q. Thank you. If you turn to the next  
4 page, three paragraphs down, starting with "The  
5 Minister..."; do you see that?

6 A. Yes.

7 Q. It states:

8 The Minister noted that the recent  
9 Ontario Demand/Supply Plan with the  
10 preferred option of building 10 large new  
11 CANDU units before the year 2015  
12 suggested a strong need to keep the  
13 nuclear option open.

14 And the question, Mr. Penn, is: Has this  
15 strong need to keep the nuclear option open in Ontario  
16 Hydro's mind been changed by the recent nuclear  
17 moratorium in Ontario or by the more recent update in  
18 the Demand/Supply Plan hearing?

19 THE CHAIRMAN: It wasn't Hydro that  
20 thought there was a strong need; it was the Minister.  
21 Isn't that right? The Minister suggested the strong  
22 need to keep the nuclear option open.

23 MR. MATTSON: I agree, Mr. Chairman.

24 THE CHAIRMAN: So I think you better  
25 rephrase your question a little differently because

1 your question suggested it was Hydro's view.

2 MR. MATTSON: No, and I didn't mean to  
3 suggest that.

4 Q. My question, Mr. Penn, is: Has the  
5 need to keep the nuclear option open, has that need  
6 been changed at all by the nuclear moratorium in  
7 Ontario and by the Update to the Demand/Supply Plan  
8 hearing, in Ontario Hydro's view?

9 MR. PENN: A. Well, I think the Update  
10 exhibit to the plan at 452, Exhibit 452, clearly states  
11 that nuclear power together with fossil generation is a  
12 future option to be considered for in-service around  
13 the year 2010.

14 So if your question is does Hydro  
15 consider that the nuclear option should be kept open, I  
16 think Exhibit 452 clearly states that.

17 Q. Mr. Penn, my earlier comment about a  
18 symbiotic relationship -- maybe I can put it another  
19 way.

20 Is it fair to say that AECL's existence  
21 is dependent upon Ontario Hydro's commitment to the  
22 nuclear option in Canada, and with respect to the 80  
23 per cent of AECL CANDUs bought by Ontario Hydro and the  
24 \$80 million a year funding provided by Ontario Hydro to  
25 AECL for research and development?



1 MR. B. CAMPBELL: Mr. Chairman, with  
2 respect, I believe AECL is represented in this hearing,  
3 and surely this is a question that should go to them  
4 not to someone at Ontario Hydro.

5 AECL is involved in all kinds of business  
6 that has nothing to do with Ontario Hydro, and I don't  
7 see how Mr. Penn or anyone else in this Panel can be  
8 expected to provide a useful opinion on that matter.

9 MR. MATTSON: Mr. Chairman, the exhibit  
10 notes that it was an AECL/Ontario Hydro working group  
11 that set up the restructure and framework for AECL, and  
12 that is what the Minister is speaking to, and Ontario  
13 Hydro was a party to that working group. It is in that  
14 context that the question is asked.

15 MR. B. CAMPBELL: Well, I think Mr. Penn  
16 has already said he doesn't know anything about the  
17 working group.

18 MR. MATTSON: And if no one on the Panel  
19 knows then that would be acceptable as an answer, I  
20 take it, Mr. Chairman.

21 THE CHAIRMAN: Well, the way the question  
22 was framed I think Mr. Campbell's point is well taken.  
23 I don't think that these witnesses can give a useful  
24 opinion as to future existence or viability of AECL,  
25 dependent on what Hydro does or does not do about its

1 nuclear future, nuclear planning.

2 MR. MATTSON: Q. If you turn to page 95  
3 of the exhibit, it is the second page of a ministerial  
4 letter to AECL employees, dated March 30th, 1990. Page  
5 94 is the start of the letter.

6 Do you have that, Mr. Penn?

7 MR. PENN: A. Yes.

8 Q. And on page 95, I note in the third  
9 paragraph under "Restructuring", fourth paragraph on  
10 the page, second sentence, the Minister states:

11 As well, Ontario Hydro has agreed to  
12 guarantee a minimum level of work each  
13 year to AECL. This will help AECL to  
14 maintain and develop its nuclear design  
15 and engineering capability.

16 Mr. Penn, I notice at the top of the page  
17 it speaks about the \$30 million annual contribution  
18 channel to the CANDU Owners Group. And is there  
19 another agreement? Is this minimum level of work each  
20 year to AECL, is that a separate agreement from the \$30  
21 million that Ontario Hydro funds to AECL?

22 A. I'm afraid I can't recall whether  
23 they are to be taken to be combined rather than  
24 additional to each other. It is certainly true that  
25 Ontario Hydro in the past did -- in order, of course,

1 in order to ensure the continued availability of AECL  
2 to assist us in returning our plants to good  
3 performance that we did guarantee a certain amount of  
4 work.

5 Somewhere I have read in your more than  
6 600, or maybe it is 800 pages now, of information you  
7 have given us in the last week a letter from Mr.  
8 Lawson, Donald Lawson, the President of AECL - it may  
9 even be in this package - which pointed out that the  
10 revenue of Atomic Energy of Canada Ltd. in 1991, of it  
11 only \$30 million in revenue before expenses came from  
12 Ontario Hydro and that the bulk of their income came  
13 from other sources.

14 Q. Including the federal government and  
15 the province of Ontario; correct?

16 A. I don't have the article in front of  
17 me, but AECL at the present moment are building or  
18 several units in Rumania; they have won a contract in  
19 Korea; I understand that they are close to negotiating  
20 another one in Korea; and, of course, they have very  
21 substantial sales of cobalt-60 and other radioisotopes  
22 in the world that brings in revenue, apart from all  
23 their research work for people all over the world.

24 MR. MATTSON: Thank you.

25 Mr. Chairman, my final area, I have some

1 concerns and I won't proceed without first notifying  
2 you.

3 There has been a discussion already in  
4 the course of cross-examination from Mr. Poch, counsel  
5 for the Coalition, with respect to drawing inferences  
6 from the issue of the Nuclear Liability Act and how  
7 that might impact upon decisions you may make about the  
8 safety of the nuclear program and nuclear generating  
9 stations in Ontario, and, if you would like, we can as  
10 well put those questions in writing, and then, if they  
11 are refused we can then argue before you, or if you  
12 would like me to proceed with the questions and deal  
13 with them on an ad hoc basis I am prepared either way.

14 THE CHAIRMAN: Well, the way we have been  
15 doing it is you ask the questions and when they go over  
16 the boundary of propriety Mr. Campbell will probably  
17 interject, and we can see where we go from there.

18 MR. B. CAMPBELL: Mr. Chairman, on this  
19 matter, if I recall correctly, the witness Panel  
20 indicated that they were unable to--

21 THE CHAIRMAN: Oh, yes, that's right.

22 MR. B. CAMPBELL: --elaborate on an  
23 interrogatory answer which spoke to the effect of  
24 certain outcomes, I believe, and with respect to the  
25 Nuclear Liability Act or having to purchase insurance.

1                   Mr. Poch, as a result of that, has  
2       submitted a series of questions, some 10 in number I  
3       believe, but given that the Panel basically was not  
4       able to deal with that matter and there is another  
5       process dealing with it I would be just as happy if my  
6       friend could review Mr. Poch's correspondence to us,  
7       add any supplementary questions that he wants, and then  
8       we could try and deal with it all consistently. But I  
9       don't think based on the answers that Mr. Poch obtained  
10      that the witnesses will be able to help him.

11                   THE CHAIRMAN: It comes back to me now.  
12      Mr. Poch at least raised a relevant issue surrounding  
13      the Statute and the future existence of the Statute,  
14      which is under attack I understand in litigation.

15                   MR. B. CAMPBELL: Yes.

16                   THE CHAIRMAN: And I recall now that  
17      these particular witnesses weren't able to really  
18      provide very much information, and so the way we  
19      resolved it was that the questions were going to be  
20      reduced to writing, and if they turned out to be  
21      something that should be answered then there would have  
22      to be a mechanism for answering them either by written,  
23      or viva voce, or a combination of the two.

24                   So perhaps that would be the best way to  
25      handle it.



1 MR. MATTSON: Mr. Chairman, then, I take  
2 it then that Energy Probe, there won't be many  
3 questions either, but we can submit our questions, or  
4 is it just --

5 THE CHAIRMAN: Perhaps you could work  
6 with Mr. Poch on this and maybe there could be some  
7 coordination, and if Mr. Poch's questions cover your  
8 areas but if you have some additional ones then you  
9 could submit them in the same manner to Mr. Campbell in  
10 the same manner as Mr. Poch has done.

11 MR. D. POCH: I will provide a copy of  
12 the questions I have already posed, Mr. Chairman.

13 MR. MATTSON: Thank you, Mr. Chairman.

14 MR. D. POCH: Mr. Chairman, just for the  
15 record, Mr. Penn referred to a quote from Mr. Lawson  
16 that appeared in the record. I think it is in our  
17 materials you saw it, Mr. Penn, and just so that is in  
18 the same place in the transcript, the news report which  
19 quotes the AECL representative is at page 10 of Exhibit  
20 578.

21 THE CHAIRMAN: Thank you.

22 MR. B. CAMPBELL: And in the Friday  
23 afternoon spirit of being helpful --

24 THE CHAIRMAN: It is only Thursday.

25 MR. B. CAMPBELL: Or Thursday. It feels

1 like Friday to me, I'll tell you.

2 I might advise my friend that in terms of  
3 the whole funding issue that he has been exploring he  
4 may recall that in the OEB hearing immediately  
5 following whatever the date is of this press release, I  
6 believe it is about March, '90, I think this whole  
7 matter was gone into in some depth at the OEB hearing  
8 at which Energy Probe participated, and they might take  
9 a look at some of the information.

10 My recollection is that Mr. Franklin for  
11 one, who was the president and chairman of the  
12 corporation at that time, was questioned on this  
13 matter, for instance, at the OEB.

14 [4:35 p.m.]

15 My recollection is that it may even have  
16 been by Energy Probe, but I am not certain.

17 So my friends, if they wanted to find out  
18 a little bit more about that relationship, I think that  
19 gives a picture of it in that information.

20 MR. MATTSON: Thank you, Mr. Campbell.

21 Mr. Chairman, just before I end off then,  
22 might I ask the Board's instructions with respect to  
23 cross-examination on any further documents we may  
24 receive with respect to seismic studies that Ontario  
25 Hydro has prepared?

1 Energy Probe did ask for all those  
2 studies and there were a bit of a surprise and we  
3 weren't prepared to deal with those today. We have to  
4 seek expert advice obviously in this area before we can  
5 cross-examine on them, and ask if that is dealt with,  
6 the concerns that we raised in Mr. Wallach's report,  
7 and if that can be accommodated, I would appreciate it.

8 THE CHAIRMAN: I think to take this in  
9 stages. First of all, you should see the documents and  
10 then you can see whether you want to ask any questions,  
11 and then if you do decide you want to ask any  
12 questions, we will see whether that's an appropriate  
13 thing for you to be doing. I think we will take it one  
14 step at a time.

15 MR. MATTSON: Thank you, Mr. Chairman.

16 MR. PENN: Mr. Chairman, since Mr. Poch  
17 was kind enough to point out this area where I quoted  
18 Mr. Lawson, for the record I would like to correct what  
19 I said because it wasn't quite right from memory.

20 Mr. Lawson in an article of January 17,  
21 1992, says:

22 Of the one billion worth of orders  
23 taken by AECL CANDU - that's the plant at  
24 Sheridan Park - last year, 1991, only  
25 about 40 million came from Hydro.

1 Thank you, sir.

2 MR. MATTSON: Those are all my questions,  
3 Mr. Chairman. Thank you.

4 THE CHAIRMAN: Well then, we can stop for  
5 the day.

6 Let me just remind everybody that the  
7 scoping session for Panel 10 will take place on  
8 Tuesday, April the 21st next, starting at 9:00 a.m., as  
9 usual for scoping sessions, with the hearing  
10 recommencing no earlier than ten in the morning once we  
11 have dealt the Panel 10 scoping, and I have no idea at  
12 the moment because I haven't looked at any of the  
13 material related to it, when we have dealt that then we  
14 will continue with the Panel 9 evidence.

15 We are not sitting next Thursday, which  
16 is the 23rd. We will sit on 22nd, which is Wednesday.

17 We can now adjourn until Tuesday, the  
18 21st at 10:00.

19 THE REGISTRAR: Please come to order.  
20 This hearing will adjourn until April the 21st, at ten  
21 o'clock.

22 ---Whereupon the hearing was adjourned at 4:40 p.m., to  
23 be reconvened on Tuesday, April 21, 1992, at  
24 10:00 a.m.

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